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In Transmissions and on Differentials and on Pinion Gears and on Worm Shafts and in Rear Wheels and in Front Wheels and in Steering Pivots and in Transmissions and on Differentials and on Pinion Gears and on Worm Shafts and in Rear Wheels and in Front Wheels and in Steering Pivots and in Transmissions and on Differentials and on Pinion Gears and on Worm Shafts and in Rear Wheels and in Front Wheels and in Steering Pivots and in Transmissions and on Differentials and on Pinion Gears and

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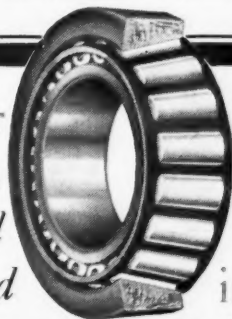
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The AUTOMOBILE

VOL. XLVIII

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No. 26

What Will Be Found in Engineering Issue of AUTOMOTIVE INDUSTRIES

Part I—Recent Engineering Trends

FACTS of vital importance about the subjects chiefly occupying the attention of automotive engineers are given in the first fifty pages of this Engineering Issue.

The leading article presents a summary of American four-wheel brake design, the first of its kind to be published. S. P. Thacher of the United States Tire Co. gives his conclusions about balloon tires in the next article, while Frank Fageol advances some novel suggestions about motor coach design in a following paper.

A series of detailed drawings of some recent developments in design of pistons, clutches, steering gears, tire carriers, combustion chambers, spring attachments and front axles gives to engineers thirty-two pages of practical assistance in designing.

Other features include an authoritative discussion of body building development and an article by J. D. Mooney on engineering as related to foreign sales.

Part II—S. A. E. Summer Meeting

AFULL report of major developments at the Society of Automotive Engineers' Summer Meeting begins on page 1416.

This meeting is particularly interesting in connection with the engineering data presented because many prominent engineers at the S. A. E. gathering expressed their ideas on the topics treated in this issue.

Summaries of the S. A. E. discussions on balloon tires, four-wheel brakes, headlamp glare, and fuel research are presented in brief, interesting form. Two pages of sketches of prominent engineers have been supplied by Leo Roche as an added feature.

Discussions at the meeting, both formal and informal, disclosed the fact that automotive engineers are taking a greater interest than ever before in the details of design. Work on engine refinements will be continued as heretofore, but technical men are turning more of their attention to other phases of motor car development.

American Front Wheel Brake Design Making Rapid Strides

Several domestic types have commendable features not found in European products. Some are operated by hydraulic pressure but majority use mechanical actuation. Only one make employs contracting band. Servo mechanisms are conspicuously absent.

By Herbert Chase

FREQUENT reference has been made in these columns to the design and application of front wheel brakes, especially on European passenger cars. It has also been reported that a number of American manufacturers are giving serious consideration to the adoption of front wheel brakes, but data on only a few American front wheel brake designs have hitherto been available for publication.

We have recently collected drawings of upward of a dozen front wheel brakes developed in this country and in Canada, and are presenting these drawings, together with descriptive matter, in order that the relative merits of various constructions may be considered in selecting or preparing future designs.

A NUMBER of American front wheel brake designs incorporate commendable features which are either absent or seldom found in European practice. Of those here described, some appear to be exceptionally light in weight and inexpensive to manufacture. Large area of contact surface for linings is a commendable characteristic of both the contracting and expanding band types. The latter is seeing wider use than formerly, probably because of its large arc of contact and light weight.

In some instances precautions are taken to avoid locking of the front wheels, especially when the latter are cramped in turning, but so-called "servo" mechanisms which are a feature of some foreign designs are conspicuously absent, doubtless because of the added complication and lack of positive functioning which their use involves.

The type of construction most widely used in France has as yet seen no commercial applications in this country, but is believed to be receiving careful consideration by some prominent passenger car manufacturers. In this type the brake camshaft is operated by a universal shaft located above the knuckle pivot and connecting at its inner end to a short shaft with bearings in the frame side member above the front axle. While this is an excellent construction mechanically, it involves the use of a larger number of parts than some other constructions. Among these are four universal joints, two of which must have sliding shafts or their equivalent, with consequent need for lubrication and dust exclusion.

Duesenberg Fitted with Hydraulic Brakes

Front wheel brakes operated by hydraulic means have been regular equipment on Duesenberg cars, since the introduction of the present chassis in 1921. In this system oil is forced from a cylinder with a piston controlled by pedal pressure to cylinders on each brake anchorage. The pistons in the brake cylinders under influence of the hydraulic pressure created actuate toggle mechanisms which move the brake shoes into contact with the drums.

The Duesenberg brake, shown in Fig. 1, is of the expanding type with anchorage at the ends of the shoes opposite to those to which the toggle mechanism is attached. Inasmuch as the hydraulic pressure is necessarily the same in the cylinders on all four wheels, the brakes are readily equalized so far as shoe pressure is concerned, and are operated simultaneously.

Piston in Master Cylinder Pedal Operated

This system is designed to operate under a maximum pressure of about 400 lb. per sq. in. The master cylinder is hinged in a bracket, which is fastened to the left side of the gearset. The piston is fitted with leather cup washers, designed to prevent liquid from passing by the piston.

Between the brake pedal and the master cylinder is a toggle mechanism which is designed to give a slowly increasing brake pressure, without requiring excessive pedal pressure. With this mechanism it is said to be easier to apply four brakes than to apply two brakes in the ordinary two-wheel brake layout. Any slight leak in the system is said to be easily detected for the reason that it permits over-travel of the brake pedal, thus bringing into action the booster cylinder which pumps additional liquid into the braking system.

When the pedal reaches a point about 2 in. from the toeboard an arm at the base of a "booster" cylinder comes into contact with the plunger in this cylinder and forces oil from a supply reservoir into the master cylinder, thus making up for any leakage which may occur. From the master cylinder oil passes through tubing to the four brake cylinders. Flexible rubber and fabric tubes designed to withstand high pressure are used where flexing occurs.

Provision is made so that the oil can be shut off from any of the brake cylinders in case leakage sufficient to render the brake inoperative occurs. This enables operation of the other brakes, pending repairs.

A mechanically operated hand brake acts on a drum fastened to the forward end of the propeller shaft and is

designed for use in emergencies and to lock the car when standing.

With the hydraulic system of braking it is said to be possible to stop the Duesenberg car within its own length when traveling at 30 m.p.h., or in about two car lengths at 40 m.p.h.

As will be seen from Fig. 1, the steering knuckle pin on the Duesenberg car lies inside the brake drum. A tubular front axle, which, of course, is strong in torsion, is employed. The design is such that the center line of the steering knuckle pin intersects the road about $2\frac{3}{4}$ in. from the central point of tire contact. A yoke arm, attached to the tubular axle, serves as the brake anchorage.

Among the advantages claimed for this type of brake is the elimination of rods and levers which are apt to cause rattles, positive equalization of pressure in the brake cylinders and on the brake shoes, and relative simplicity of construction.

Another design of hydraulic brake employing the same fundamental principles employed in the Duesenberg installations, but used to actuate a contracting band type of brake rather than one of the expanding shoe types, has recently been brought about by the Four-Wheel Hydraulic Brake Corp. This is the only contracting band brake for front wheel application which has thus far come to our notice.

This new design, shown in Fig. 2, is intended for manufacturers' installation and does not employ the vacuum "servo" unit used in some earlier design of the same make. In this case pedal pressure acts directly on the plunger in the master pressure cylinder without an intervening toggle mechanism. In the brake actuating cylinders there are two pistons which move in opposite directions, against levers arranged to contact directly with rods riveted to each end of the brake band. These rods are so placed as to give a direct tangential pull dur-

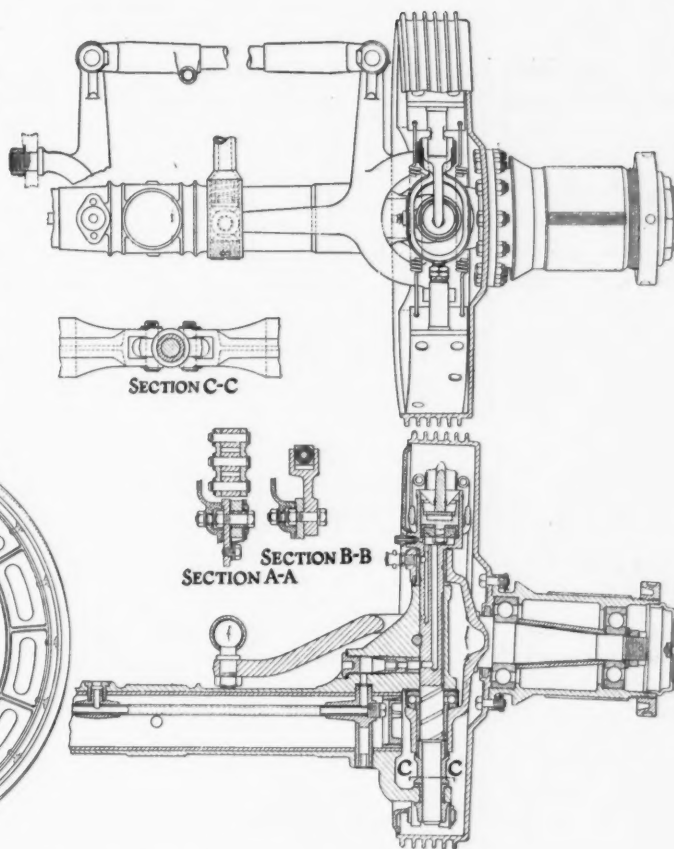


Fig. 1—Arrangement of hydraulic brake on Duesenberg front axle

ing application. This is said to eliminate cocking of the band and any tendency for the ends of the band to be distorted or dig into the drum. A convenient form of screw adjustment is fitted over the ends of the rod on the band as will be seen from the accompanying cut. In the design shown, the brake band has a contact of over 240 deg. of the drum surface.

In application of this brake to the front wheels it is recommended that a reverse Elliott type of axle be employed. As with all front wheel brake installations, it is desirable to so arrange the knuckle pivot as to have its

axis intersect the road at or near the central point of tire contact, in order that the moment tending to turn the wheel about the knuckle pivots be reduced to as near zero as possible when the brake is applied. In the design shown in Fig. 2, with a 32-in. tire, the extension of the pivot pin axis strikes the ground $\frac{3}{8}$ in. from the central point of tire contact.

In this instance the hydraulic brake cylinder serves also as a brake anchorage. It will be noted that flat springs, contacting with hook-shaped pieces welded to the band, are used to hold the band away from the drum at the bottom. In the off position the springs force the band outward against adjustable stops which, in this case, are bell cranks.

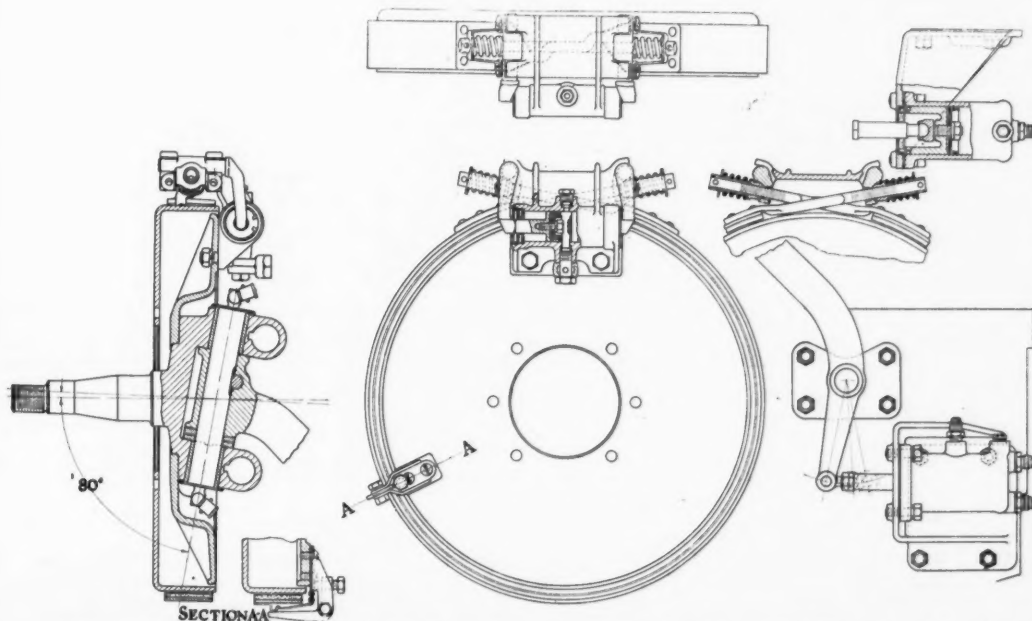


Fig. 2—Four-wheel Hydraulic Brake Corp. contracting band type of front wheel brake. Master cylinder, operated by pedal, is shown at right

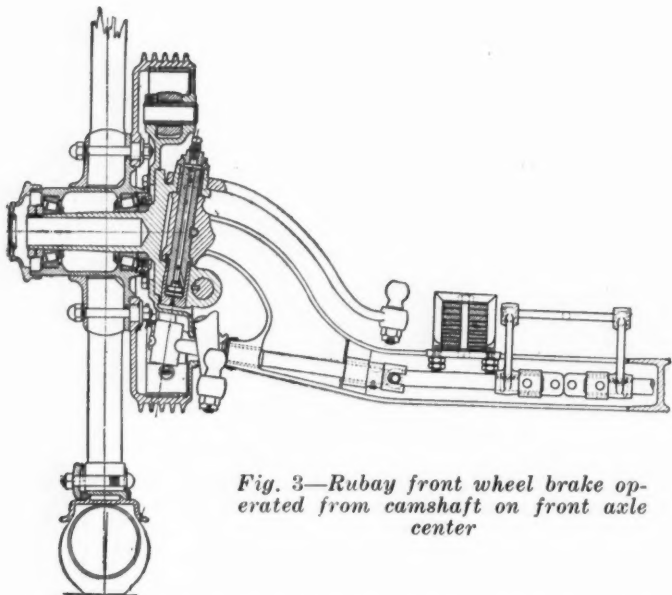


Fig. 3—Rubay front wheel brake operated from camshaft on front axle center

A mixture of alcohol and glycerine, which has a low freezing point, is the fluid recommended for use with hydraulic brake systems. A reservoir for this liquid, usually mounted on the forward side of the dash, is connected through a check valve in such a way as to replace by gravity any leakage from the closed pressure system. While high pressures are employed with the hydraulic system, these pressures exist only during the period of brake application.

Contracting Band a Simple Type

The contracting band type of brake has been selected for the accompanying design, it is said, because of its simplicity, light weight, ease with which good wrapping action is secured, and the minimizing of lost pedal motion due to the distortion of the drum. With this type of brake, servo mechanisms are said to be unnecessary.

A number of interesting points are to be found in the design of the front wheel brake employed on the Rubay chassis. In some respects the brake is similar to certain foreign designs, although adapted to American methods of manufacture. The camshaft is mounted on the arched E-section axle center, approximately in the neutral axis of the beam, so as to be least influenced by deflection of the axle under load. It will be noted that the cam is arranged in such a way that its central plane lies in the axis of the steering knuckle pivot and immediately below this pivot. The cam is slipped over the trunnion end of the operating shaft, but is so arranged that it can

turn about the axis of the knuckle pin when the wheel is turned in steering from a straight course. This, of course, avoids application of the brakes through the act of turning the wheels.

The cam bears against hardened steel mushroom disks, the shank of which is threaded into the end of the brake shoes and locked by a pinch bolt.

It will be seen from Fig. 3 that this brake is of the expanding type, with the shoes hinged to an anchorage at the top of the drum. The camshaft has a universal joint, in order to accommodate itself more nearly to the arch in the axle. There is a separate camshaft for each of the front wheels, and each shaft carries at its inner end a ball ended C-shaped lever. The two ball ends are connected by an equalizing bar, which is in turn connected to a steel tape at its central point. The length of the camshafts are so proportioned that the tape comes about 3 in. inside the spring and thus clears the low point on the engine.

How Rubay Brakes Are Equalized

The rear brakes are equalized in a manner similar to that employed in connection with the front wheel brake, and the front and rear equalizers are connected to the pedal mechanism by 15-gage spring steel tape. Both front and rear wheel brakes are operated simultaneously by the brake pedal through a third equalizing bar, arranged to give the same pull on front and rear sets. The steel tapes are fitted with forged ends, having gravity type adjusting nuts, for initial adjustment.

Wear on both front and rear wheel brakes is taken up by a single gravity nut on a vertical rod which adjusts the pedal in relation to the bell crank by which the brakes are actuated.

The outline and other details of the brake cam are shown in detail in Fig. 3. The surface of the cam follows approximately a portion of the involute curve. The cam is ground for accuracy of outline.

The Rubay brake drum is of aluminum with a 35-point carbon steel lining cast in place. This lining is beveled on the edges and drilled for anchor holes. The ring is then sherardized, placed in the mold, and the aluminum cast around it. The aluminum is said to make an excellent bond with the zinc used in the sherardizing process even without the anchor holes. The casting with lining in place is machined all over so that the lining is truly concentric with the bore.

The front wheel spindle is identical in dimensions with the live rear axle in order that the same bearings may be used on both. The large dimensions of the front spindle are said to be necessary to withstand the greater

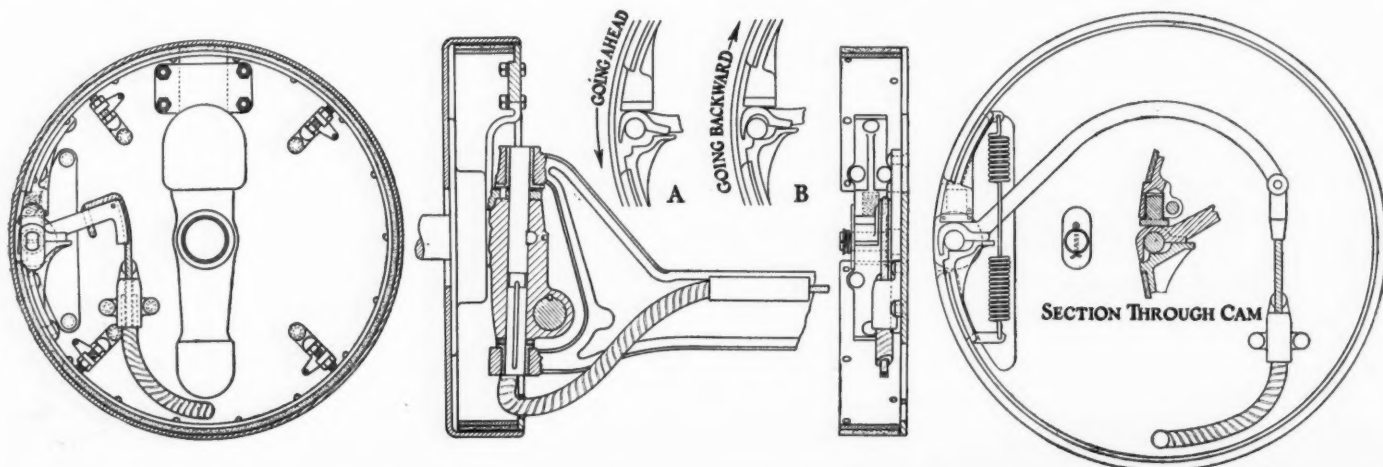


Fig. 4—Sanford expanding band brake operated by cable. The hook shaped cam is integral with operating lever

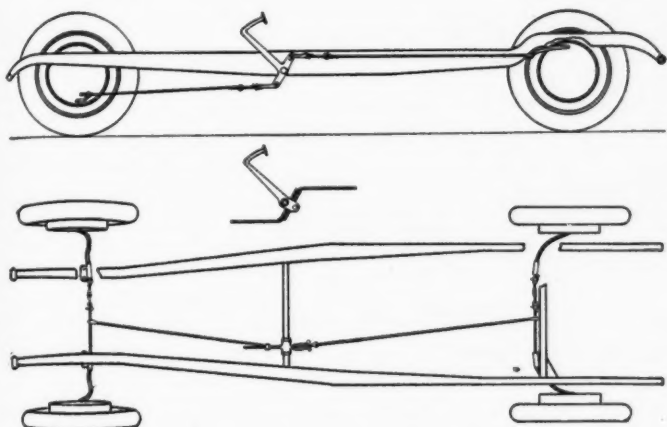


Fig. 5—Hookup employed on Sanford four-wheel brake

stresses imposed by the front wheel brakes. It will be noted that the knuckle pin has a transversely inclined axis and is arranged for a reverse Elliott type of axle center.

Certain types of brakes are cable operated and depend upon a certain degree of flexing in the cable to prevent motion of the front wheel about the axle pivot from interfering with the operation of the front wheel brake. Among these is the Sanford fore wheel brake, drawings of which are shown in Fig. 4.

By reference to this figure it will be noted that this brake embodies a light construction, in which an internal expanding band is employed instead of the more conventional hinged shoes. The actuating levers of the two front wheel brakes are connected by a cable which runs across and parallel to the front axle. Near each end of the axle are flexible tubes, the inner ends of which are attached to the axle center. The outer ends of these tubes pass through the inner brake drum covers at points approximately in the axis of the knuckle pivot. The tubes are then bent upward and anchored in hollow fittings, through which the cables pass to the ends of the levers to which they are secured.

The brake anchorage consists of a cylindrical pin, secured to the brake drum cover, and located between fittings attached to each end of the brake band. These fittings have flat bearing faces, which are approximately parallel to radii and which bear against a hook-shaped cam which is made integral with the end of the operating lever. The inner face of this cam bears against the anchor pin when the brakes are applied while the car is going ahead. The act of applying the brake turns the lever about the pin and causes the outer face and heel of the cam to force the fittings on the ends of the brake band apart and thus apply the brake. It is claimed that this cam can always be designed so as to effectually prevent locking of the wheel and still give maximum braking action.

The position of the cam and brake band fittings with brake applied during forward motion of the car is shown at A, Fig. 4. The position during backing is shown at B, Fig. 4. In the latter case one of the brake

band fittings comes in contact with the anchor pin and the cam is lifted away from the pin and into contact with the other end of the band. Further motion of the cam causes the brake end fittings to be forced apart and the brake applied. It is claimed that in rearward motion the brakes are easily locked, so that there is no danger of the car rolling backward out of control on a hill.

The Sanford brakes are said to be self-equalizing for the following reason: If both brakes, when applied, are pushed down on their respective cams with the same force, the brakes are equalized. If, however, the friction on the two bands is not the same, an unequalized condition will be brought about in the cross cable. The band which is pushed the hardest will tend to pull that end of the cable harder, and thereby apply the other brake harder until the two are equalized.

The Sanford brake is also applicable to rear wheels, the two rear wheel brakes being connected by a cable running parallel to the rear axle. The cable across the front axle and that across the rear are then inter-connected by a third cable running fore and aft of the car, as shown in diagram, Fig. 5. If desired, pulleys can be used at the junctions of the fore and aft and the transverse cable. This construction has been employed in the case of Miller racing cars.

An alternative construction of the Sanford brake, using a longer actuating lever connected to the cam, is also shown in Fig. 4. In this case a mushroom-shaped stud is screwed into one of the end fittings of the brake band and locked with a pinch bolt, thus forming an adjustable bearing surface for the cam.

U. S. Axle Co. Front Wheel Brake

A front wheel brake design, put out by the U. S. Axle Co. has already been described in *AUTOMOTIVE INDUSTRIES*. This design, shown in Fig. 6, employs expanding brake

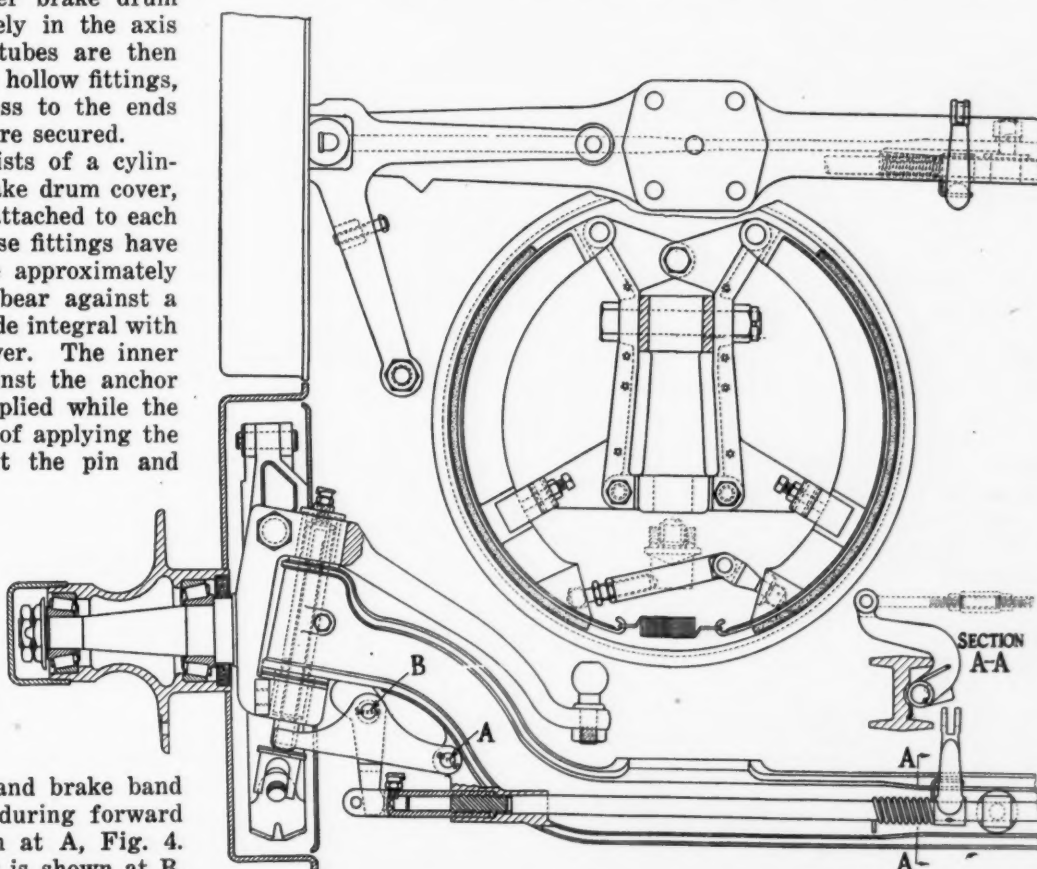


Fig. 6—Toggle operated front wheel brake put out by U. S. Axle Co.

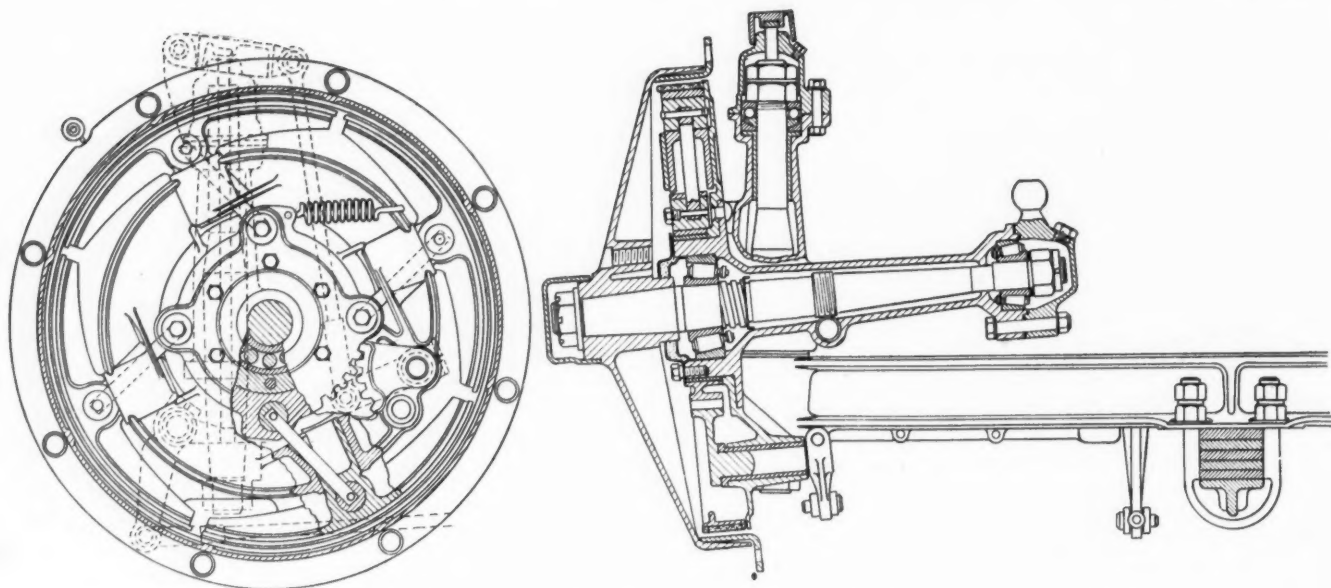


Fig. 7—Lavoie, a Canadian design of expanding front wheel brake giving large arc of contact between shoes and drum

shoes, hinged and anchored at the top, and separated by toggle action at their lower end. The knuckle pin is inclined so that the extension of its axis meets the ground approximately at the central point of tire contact. The pin is made hollow to receive the stem of a yoke-shaped fitting, which straddles and bears against one of the two toggle links at a point in the axis of the steering knuckle. The stem of this knuckle is free to turn inside the king pin and to slide axially therein.

Bearing against the upper face of the yoke end is a second yoke integral with a lever pivoted to the axle center at A. A second lever, pivoted at B to the first mentioned lever, is arranged to bear at its upper end against the under side of the axle center, while the rounded lower end bears against the bottom of a slot in a sleeve which has its bearings within a boss at the end of the horizontal portion of the axle center. This sleeve has an internal thread of coarse pitch which mates with a similar thread on the end of the brake actuating shaft. This shaft runs nearly the entire length of the axle center. Attached to this shaft, at any convenient point in its length, is a lever which can be connected by rod or cable to the brake pedal or hand-brake lever.

Turning the brake shaft by a pull on this lever causes the sleeves on the outer ends of the shaft, one of which has a right- and the other a left-hand thread, to move outward and contact with the vertical lever pivoted at B. Forcing the lower end of this lever outward causes the upper end of the lever to come in contact with the under surface of the axle center forging. The point of contact then becomes the fulcrum. Further motion of the vertical lever moves the yoked lever about pivot A and forces the yoke, which bears on the toggle downward on the toggle link, thus actuating the brake shoes.

How U. S. Axle Co. Brakes Are Equalized

With this system the front wheels can be inter-connected in any desired manner, either with brakes on the rear wheels or those operating upon the propeller shaft. The brake actuating shaft carried upon the axle center is free to slide longitudinally in its bearings, and thus bears with equal pressure upon levers pivoted at B. This is said to result in the proper equalizing of the brakes.

The brake shoes in the off position rest against stops

attached to the brake anchorage. The toggle linkage has ball ends which fit into sockets, formed in the lower ends of the brake shoes. On one of the links of the toggle there is a simple screw adjustment with lock nuts, by means of which the length of the toggle can be adjusted.

As will be seen from the drawing, the axle is of the reverse Elliott type. The brake anchorages are securely attached to the knuckle forgings.

A front wheel brake which originated in Canada, but which may be considered an American product, as distinct from those produced in Europe, is the Lavoie design, shown in Fig. 7, which has already been described in these columns. This brake differs from most other designs in that it utilizes four brake shoes instead of two—thus having a greater area of contact with the drum—and in the form of actuating mechanism employed. Incidentally the axle itself is quite distinctive in design, owing to the use of a live axle spindle, which is tilted in an angle of $4\frac{1}{2}$ deg. horizontal. This enables the use of a vertical steering pivot, which at the same time gives substantially center point steering.

Lavoie Brake Has Novel Actuating Means

In the Lavoie design the brake actuating shaft is carried on the axle center, and is provided with a short lever arm that actuates a pin which runs from end to end of the vertical knuckle pivot and is concentric therewith. This pin bears at its upper end upon a lever hinged to, and therefore turning with, the knuckle about the vertical axle. The other end of this lever carries an eye rod which extends perpendicularly downward and terminates in a yoke attached to lever arm on a serrated shaft extending through the flange which incloses the drum and forms the brake anchorage. At the inner end of the serrated shaft is a gear segment, the teeth of which mesh with teeth cut in a spider, mounted concentrically with the wheel. This spider has four ears, to each of which is pivoted a toggle lever. On the outer end of each lever is a brake shoe, hinged to the end of a stub shaft, which is free to slide radially outward in guide blocks which serve as an anchorage.

Motion of the gear segment turns the spider about the wheel center and thereby forces the toggles and their respective brake shoes outward into engagement with the drum. The brake shoes are self-centering, so that

wear on the lining is equalized. The shoes are of cast iron and are capable of functioning even after the lining is entirely worn away. The design is such that the shoes have a radial motion of at least $\frac{3}{8}$ in.

A similar design of brake is employed on the rear wheels of the Lavoie car.

Another design of front wheel brakes, which, so far as we are aware, is still in the experimental stage, is that of F. A. Truesdell, which is reproduced in Fig. 8. In this design an expanding type of brake is arranged to be actuated by a pinion mounted on a short stub shaft and engaging with two racks cut in fittings attached to each free end of the two brake shoes.

Among the other features of this design, upon which patents are pending, may be mentioned a simple means whereby the brake is partly or wholly released when the wheels are cramped, thus preventing locking, which sometimes results in skidding or in rendering the car unsteerable in case the front wheels become locked when turning.

From the drawing it will be seen that a shaft carried on the axle center is provided with an arm which is arranged to pull downward on a socket link, which fits respectively over the ball end of the lever attached to the axle shaft and of a second lever, attached to the shaft carrying the pinion referred to above. By rocking the shaft attached to the axle center, the connecting rod is caused to move upward, thus rotating the pinion and applying the brake.

Cramp Wheels Release Truesdell Brake

Since the upper lever attached to the pinion shaft is carried on the steering knuckle, the end of this lever moves through an arc as the steering knuckle is turned about the knuckle pin axis. The connecting rod is, however, constrained to move through an arm described by the upper end of the rod, turning about the center of the end of the lower lever. In so doing the rod is, in effect,

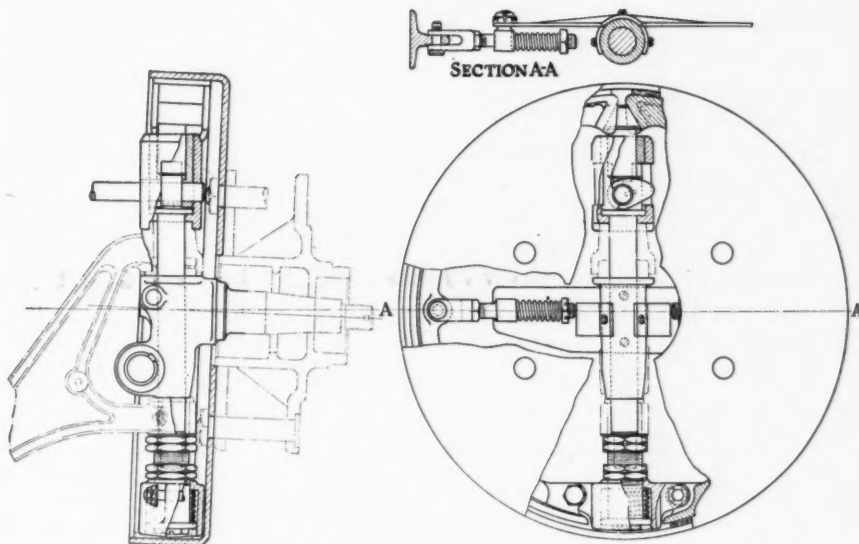


Fig. 9—Clapp front wheel brake

foreshortened a small amount, in proportion to the cosine of the angle of travel, but a sufficient amount to cause the brake to wholly or partly release.

Two designs of this brake are shown in Fig. 8, one as applied to a wood wheel, turning about a transversely inclined knuckle pivot, and the other as fitted to a steel disk wheel, turning about a pivot which is nearly vertical, owing to the arrangement of the wheel spindle with a bearing inside the knuckle. This construction gives substantially center point steering without inclining the pivot more than 2 deg.

A front wheel brake design, produced by Major Stuart H. Clapp of the Ordnance Dept., U. S. A., and reported to have undergone successfully tests on several cars used at the Army Post, Camp Mead, Md., is shown in Fig. 9, as adapted to a conventional front axle of the Elliott type. In this case the knuckle pin has simply been extended top and bottom in such a way as to provide a brake shoe support and anchorage at its lower end and to carry a brake operating mechanism at its upper end.

It will be observed that the brake is an expanding type, in which the shoes are hinged at the anchorage and are

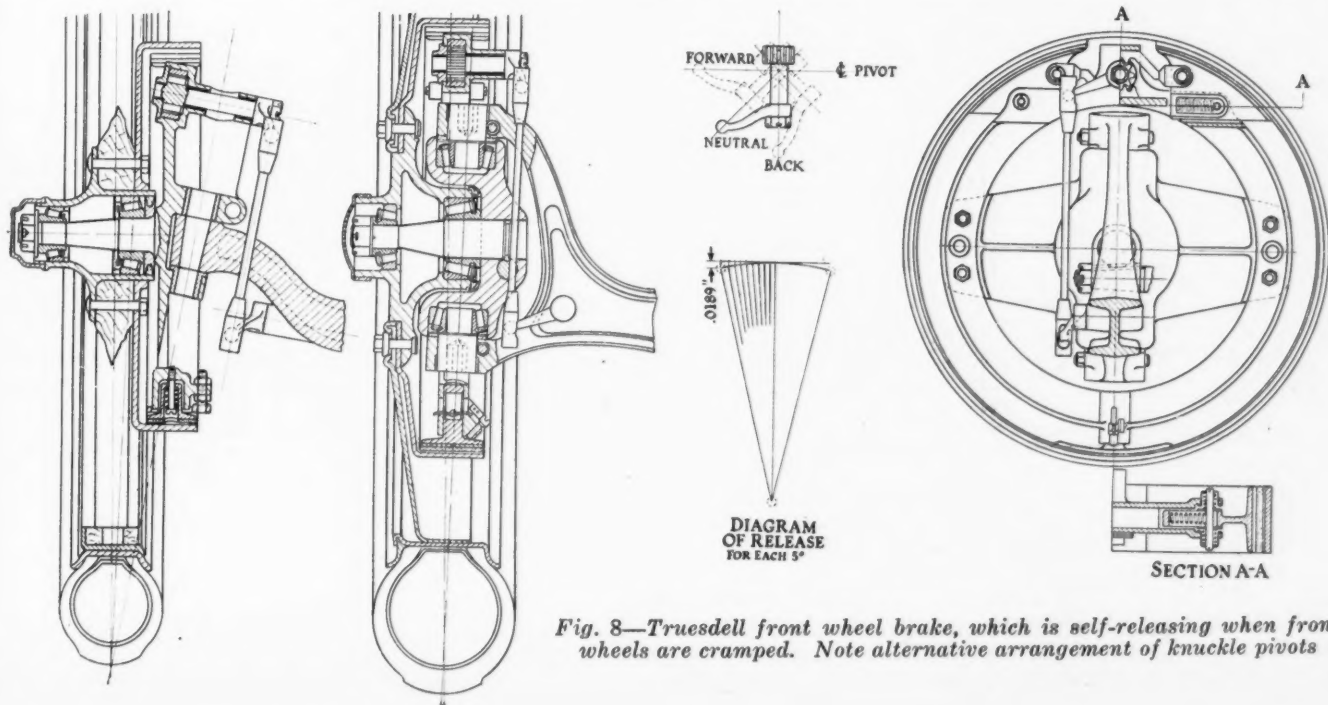


Fig. 8—Truesdell front wheel brake, which is self-releasing when front wheels are cramped. Note alternative arrangement of knuckle pivots

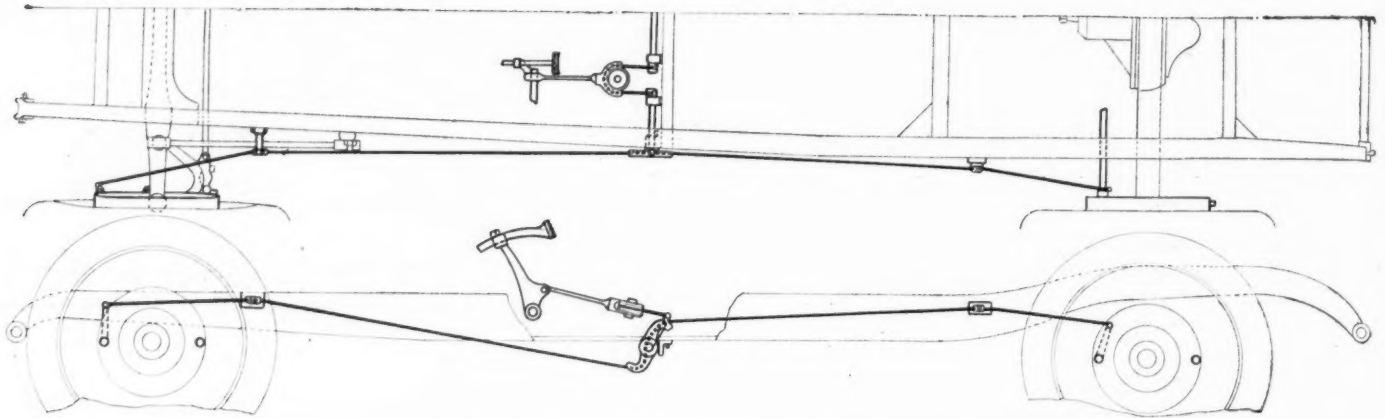


Fig. 10—Landry four-wheel brake hookup. Cables are employed. Brakes on right and left of chassis are equalized by pedal sheave

forced apart at their upper ends by a wedge having a 60 deg. included angle.

The wedge is formed on the upper end of a stub shaft, the lower end of which is in contact with a cam. The axis of rotation of the cam is at right angles to the knuckle pivot with which the cam is in line. In other words, the central plane of the cam, at right angles to the cam face, lies in the axis of the knuckle pin. This cam is keyed to a short shaft whose bearings are in a bushing surrounding the upper end of the knuckle pin. This bushing rests on the upper yoke end of the axle center, of which it is virtually a part, and is slotted in such a way that it fits over the yoke and cannot turn when the king pin is turned.

The stub shaft carrying the wedge is free to move axially as well as to turn in this bushing so that motion of the wheel about the king pin has no tendency to apply the brake.

Turning of the camshaft by any convenient lever attached thereto causes the stub shaft and its wedge-shaped end to rise and spread the ends of the brake shoe apart, forcing them into contact with the drum. The camshaft, being secured to the axle center, moves with it and is not affected by turning of the knuckle when the car is steered from a straight course.

The hollow casting, to which the brake shoes are hinged,

is carried on a lower extension of the king pin and is free to slide a short distance axially on this pin when the shoes are forced into contact with the drum. This anchorage is, however, normally held against a stop in its upper position by a spring which keeps the lower end of the shoes out of contact with the drum when the brake is in its off position.

Applying the brake and expanding the brake shoes, however, forces the lower end as well as the upper ends of the shoes into contact with the drum, thereby giving contact over a large proportion of the inner circumference of the drum.

Brake Mechanism Protected from Dust

The upper ends of the brake shoe are held in contact with the wedge block by two compression springs. These springs are fitted over rods which are free to slide in a radial direction under influence of the springs and thus carry with them the brake shoes to which the rods are attached by yokes and clevis pins. This feature of the construction is illustrated in section AA, Fig. 9. The flange or bracket which carries the brake retractor rods is made integral with, or attached to, a dust shield which closes the drum on its inner side and protects the brake mechanism from accumulation of mud or dust.

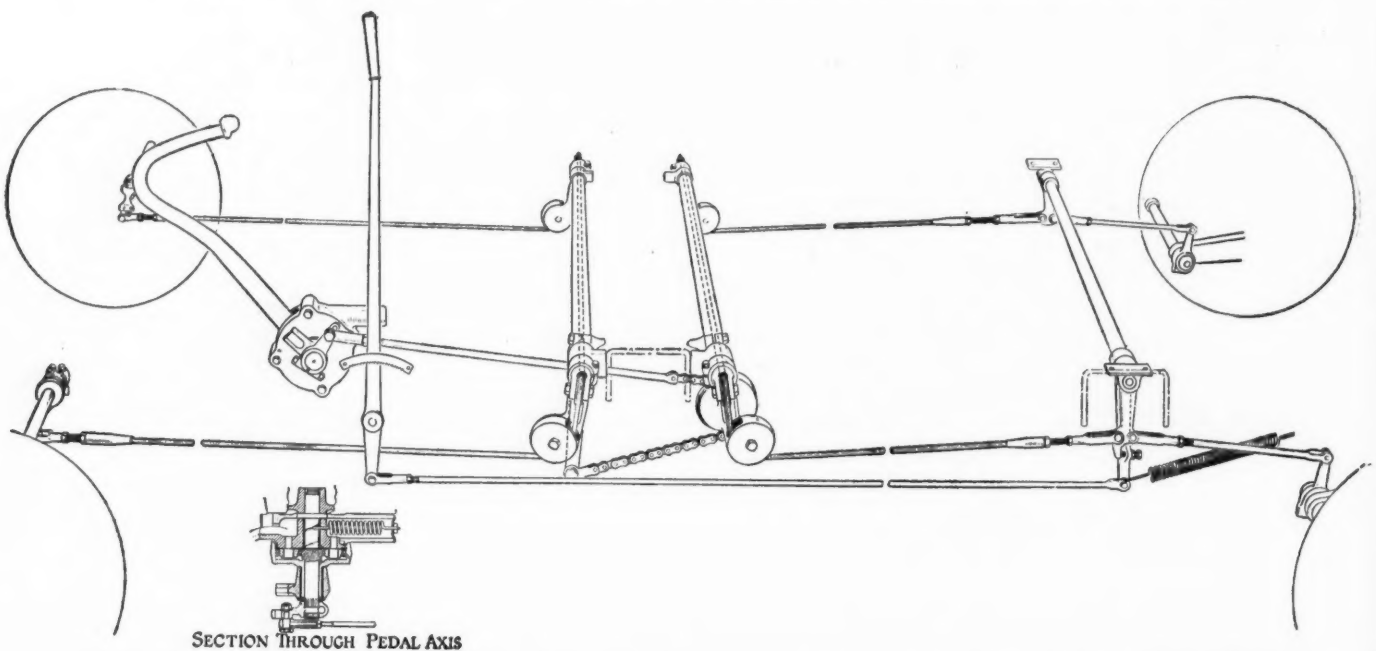


Fig. 11—Arrangement of brake operating mechanism on new Packard eight-in-line chassis. A planetary gear is used on brake pedal

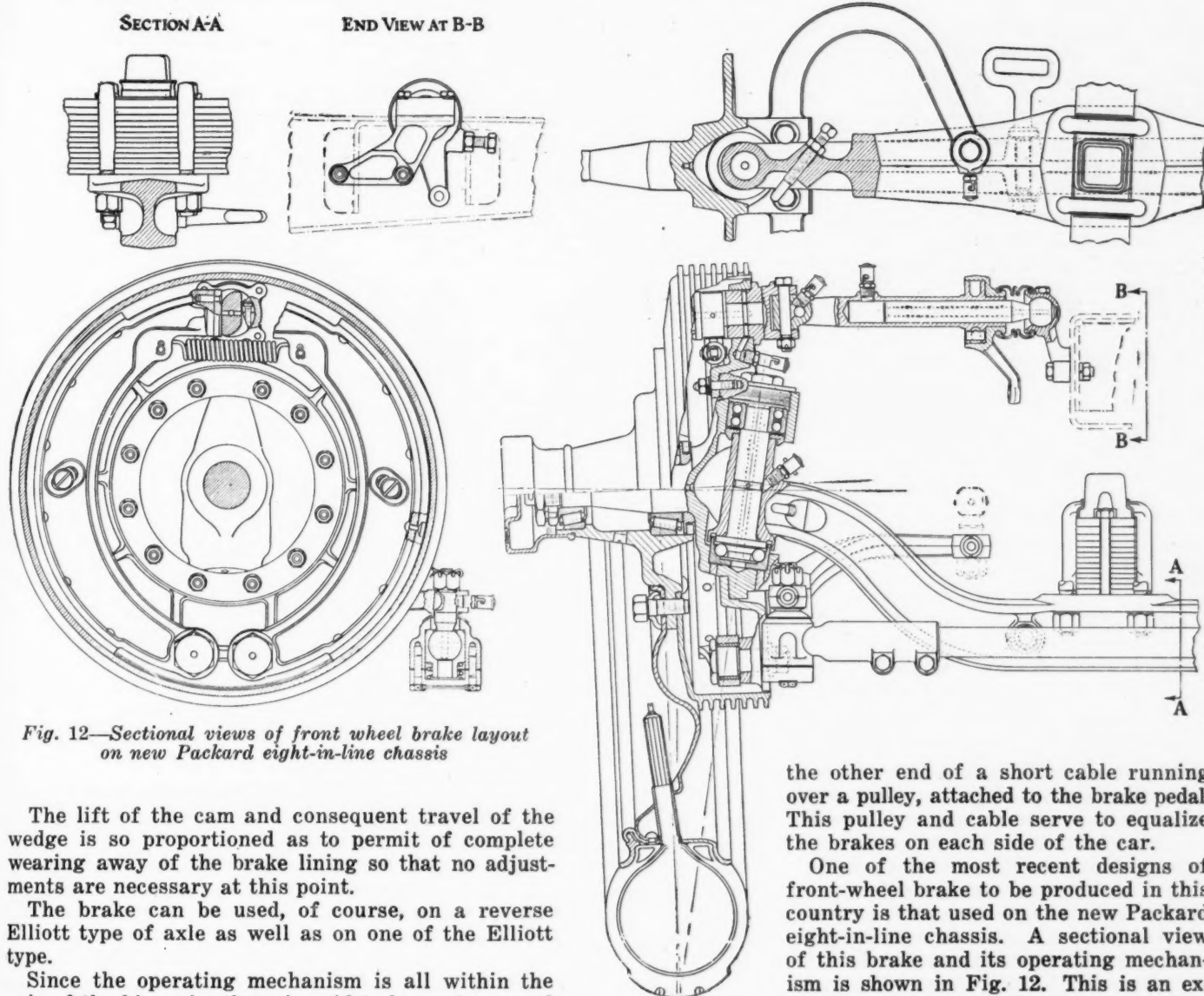


Fig. 12—Sectional views of front wheel brake layout on new Packard eight-in-line chassis

The lift of the cam and consequent travel of the wedge is so proportioned as to permit of complete wearing away of the brake lining so that no adjustments are necessary at this point.

The brake can be used, of course, on a reverse Elliott type of axle as well as on one of the Elliott type.

Since the operating mechanism is all within the axis of the king pin, there is said to be no increased resistance offered to steering. The action of the retractor springs is said to eliminate all rattle and the brake shoes are said to be self-centering. No universal or slip joints are required in the operating mechanism.

Another front wheel brake of the expanding band type, which is cable operated, is that of the Landry Mfg. Co., shown in Fig. 10. In this layout the brake camshaft is carried in a bearing, attached to the anchorage plate, which forms the inner enclosure of the brake itself. To this shaft is fitted a lever, the upper end of which is in the form of a socket, containing a ball attached to the operating cable. From this lever the cable passes to a guide on the frame, about half way between the axle and the steering gear, and thence approximately parallel to the frame, through and over an S shaped lever pivoted on a transverse shaft. After passing over this S lever the cable runs to a second guide, forward of the rear axle, and thence to the brake lever on the rear axle.

Thus the front and rear brakes on the same side of the car are directly interconnected by the cable. The S lever, in combination with a pulley and cable on the brake pedal, is said to compensate for the tension or slack in the cable which results from turning the wheel about the knuckle pin in steering.

The shaft or tube carrying the S levers on each side of the frame is divided at a point opposite the brake pedal. To the inner ends of the brake shafts are fitted levers, one of which is connected to one end and the second to

the other end of a short cable running over a pulley, attached to the brake pedal. This pulley and cable serve to equalize the brakes on each side of the car.

One of the most recent designs of front-wheel brake to be produced in this country is that used on the new Packard eight-in-line chassis. A sectional view of this brake and its operating mechanism is shown in Fig. 12. This is an expanding shoe, operated from a camshaft

arranged between the frame and brake drum directly over the front axle. So far as this part of the mechanism is concerned the design resembles some of those built under Perrot patents in France. With this type of construction it is necessary, of course, to have a universal joint located approximately in line with the knuckle pivot, while the camshaft must contain a sliding joint to permit of changes in position of the universal in relation to the frame as the axle moves with spring action.

In this case the inner end of the camshaft is made hollow and telescopes over a stub shaft with ball end fitting into a socket attached to the side member of the frame. The lever which rotates the camshaft is attached to a cable which runs through the frame over an equalizing mechanism, described below, and back on the other side of the chassis to the lever on the opposite front brake camshaft.

Packard Uses Aluminum Brake Shoes

The brake shoes are arranged in more or less conventional fashion with pivot and anchorage at the bottom. They are aluminum, faced with copper asbestos fabric, and provided with steel bearing surfaces for the cam, which has a rounded surface. The high carbon steel brake drum is ground on its inner diameter and provided with external cooling ribs.

The axle end is of the reverse Elliott type and is provided with an inclined knuckle pin which turns in a

double row annular ball bearing at the top and a cup and cone thrust bearing at the bottom. The pin is so arranged that the projection of its axis meets the ground at the central point of tire contact.

As will be seen from the accompanying diagram, Fig. 11, both front and rear brakes are controlled by a cable system operated by the brake pedal. The rear brakes can be operated also, independent of those on the front wheels, by a conventional hand lever.

The cable which controls the front brakes, after passing through the frame is carried over sheaves, through the forward equalizer shaft, and thence to the brake on the other side. The sheaves are carried on levers which are attached to and turn with the equalizer shaft and are calculated to permit the cable to so adjust itself as to give the same pull on each brake. A similar equalizer shaft for the rear brakes is carried back of the central frame cross member, the cable in this case connecting with two levers attached to a third cross shaft bracketed under the frame cross member which is located opposite the front ends of the rear springs. The last mentioned levers are in turn attached by short brake rods to the levers on the camshafts which operate the two rear brakes.

It will be noted that the cable which controls the rear brakes passes over sheaves on the operating levers and through the equalizer shaft, giving an arrangement precisely similar to that which operates the front wheel brakes, so far as the equalizing mechanism is concerned.

Planetary Gear on Packard Brake Pedal

The two equalizer shafts are turned by a link chain attached to a brake rod, the forward end of which is connected to a crank operated by a planetary gearset from a master gear on the brake pedal. The outer end of the chain is attached to a lever on the forward equalizer shaft and the chain itself passes over a sheave carried on the end of a lever attached to the rear equalizing shaft. It will thus be noted that the chain forms the means for interconnecting and equalizing the front wheel and the rear wheel brakes.

The lever operated by the planetary gear is arranged to swing through an angle of 90 deg. as compared to an angle of motion of the brake pedal of 26 deg. The arc of travel of this lever is such that the rod attached to it moves a much shorter distance through the last part of its angular motion than it does through the first part, so that the leverage increases progressively as the pedal is depressed.

The lower end of the hand brake lever is attached to the forward end of a rod the rear end of which is connected to a loose lever on the rearmost brake shaft. Pulling the hand brake lever moves the loose lever into contact with one of the levers attached to the same shaft, causing the latter lever to move forward with the loose lever, thus applying the rear brakes only and enabling the car to be locked when standing. It will be noted, however, that both front and rear brakes are operated simultaneously and without interference with the hand braking mechanism when the brake pedal is depressed.

Shuler Brakes Employ Face Cams

A design of front-wheel brake developed by the Shuler Axle Co. for bus and truck service is shown in Fig. 13. This is a toggle operated expanding band type. The toggle links, which are adjustable for length to permit of initial and wear adjustments, are attached near the ends of the brake shoes and to the arms of a spider the hub of which fits over the upper end of the steering knuckle pin to which it is keyed but is free to move axially. The knuckle pin is keyed to the knuckle forging and arranged to turn with it, the ends of the axle yoke being suitably bushed.

The bushing in the upper yoke is provided with an end or face cam against which fits a mating cam formed on the hub of the brake operating lever. This lever hub is located between the bushing and the spider to which the toggles are attached. The mating surfaces of the cams are true helical surfaces. A pull applied to the end of the brake lever causes it to rise on the knuckle pin and carry with it the toggle spider, thus applying the brake through the toggle links.

When the front wheel is moved in steering, the brake lever with its end cam and the mating cam on the yoke bushing remain stationary, so that the brakes are not affected by the steering action.

The brake band is carried on a lower extension of the knuckle pin, where a spring is provided to keep the band out of contact with the drum. The latter is made from 3½ per cent nickel steel. The brake band is formed to a true circle and covered with asbestos fabric. The cam bushing is of cold drawn steel, which is carbonized, hardened and ground.

In this design the knuckle pin is set vertically and the wheel spindle inclined 2 degrees. The axle center is of the Elliott type, while in most front wheel brake designs a reverse Elliott type is employed on account of the fact that it lends itself to a rather compact design and gives

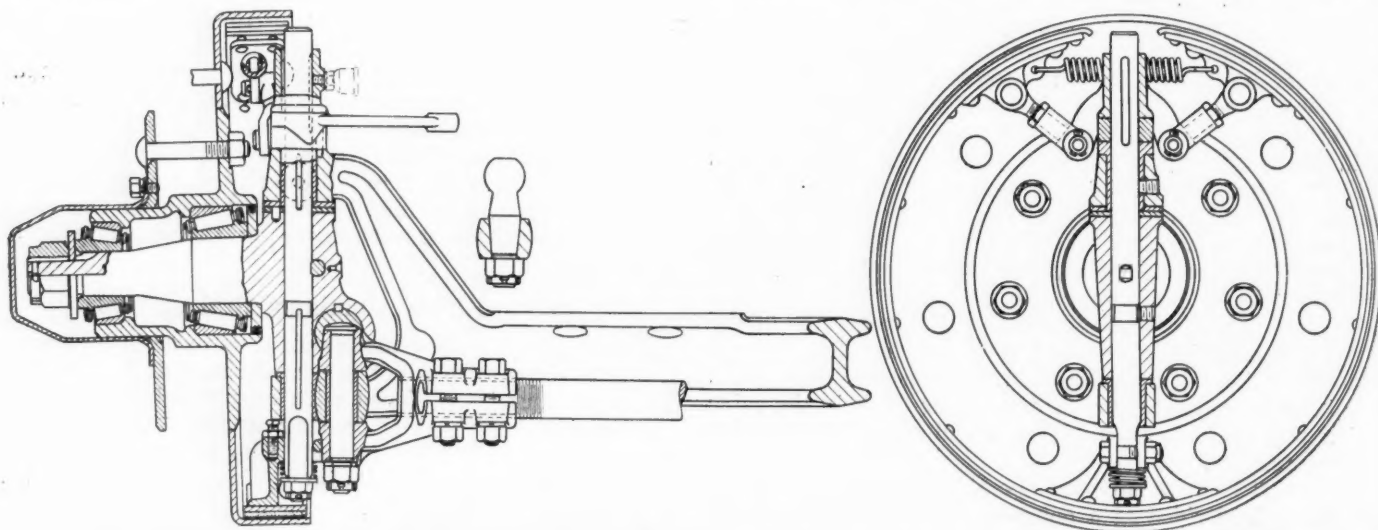


Fig. 13—Shuler front wheel brake for truck and bus application. Brake is applied by face cams mounted on an extension of the knuckle pin

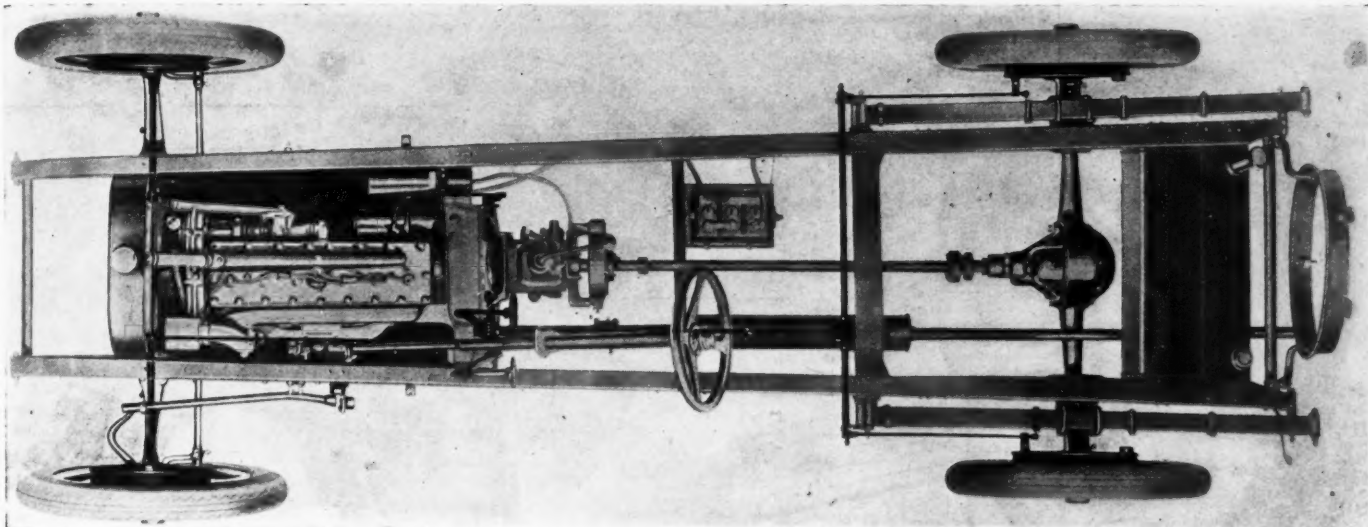


Fig. 14—Brake hookup on Rickenbacker chassis with four-wheel brakes. Hand brake operates on propeller shaft only. Wheel brakes are equalized by differential gears on pedal shaft and rear cross shaft

ample space for the brake actuating mechanism. The type of mechanism employed in the Shuler design, however, permits of the use of a rather wide yoke which, of course, enables the knuckle pin bushings to be spaced quite a distance apart with corresponding advantage in respect to the loads which they carry.

A neat and well worked out four-wheel braking system is that used on one of the two Rickenbacker chassis, concerning which information has just been made available for publication, although this system has been under development for the past three years. In this case all of the four wheel brakes are substantially identical in design and all are operated by camshafts carried in bearings fixed to the front and rear axles. An entirely separate hand brake operates on a drum on the forward end of the propeller shaft.

Various views of the Rickenbacker front-wheel brake installation and axle parts are shown in Figs. 14, 15, 16 and 17.

There is a divided brake shaft at the clutch housing for the front-wheel brake and one just forward of the cross member supporting the front ends of the rear spring for the rear-wheel brakes. Each of these shafts has a differential gear equalizing unit between its two parts. The pressure of the brake pedal rotates these shafts through the differential units, giving equalized pull on the rods which reach from the cross shafts to the front and rear brake camshafts, respectively. The rear brake camshafts are arranged in conventional manner, while the front brake camshafts pass through bosses in the reverse Elliott axle center. These bosses not only act as retainers for the camshafts but also provide the extra section necessary to give torsional strength to the axle.

Shift in Weight Offset

The cross shaft for the front wheel brake is concentric with the clutch shaft, so that the clutch shaft operates through the center of the hollow brake shaft. The brake shaft has a stirrup which carries it around under the clutch shaft at the clutch yoke and has splined to it two brake pull levers which actuate the pull rods to the front-wheel brake camshafts. The pull rod for the rear-wheel brakes is attached to a boss on the pedal, so located as to give a slightly greater leverage to the rear-wheel brake to offset the shift in weight on the wheels during retardation.

The front-wheel brake pull rods actuate C-shaped levers, which in turn rotate the brake camshaft and with

them the operating cams. The camshaft and the cam itself are floating members, the camshaft being supported by a bearing at its inner end in the boss in the front axle. This shaft passes through an oil packing and a flexible boot attached by a flange to the brake cover plate. The outer end of the camshaft carries a sort of rhomboid, or diamond shape equalizing block, which floats freely in the slotted end of the camshaft. Two sides of the equalizing block bear against the slot and two sides against the case hardened follower faces through which the shoes are expanded. Since the equalizing block floats freely it finds its own center and exerts an equalized pressure on the two brake shoes, thus compensating for any difference in wear between the two shoes or any initial difference in clearance. The return springs passing across the brakes from one shoe to the other center the brake shoes on the cam.

The cam follower faces not only function as such, but act also as a bearing surface when the front wheel is rotated about its vertical axis in steering. The center



Fig. 15—Divided shaft and equalizer for Rickenbacker front wheel brakes. Pull rod for rear brake equalizer is attached direct to upper hole in pedal

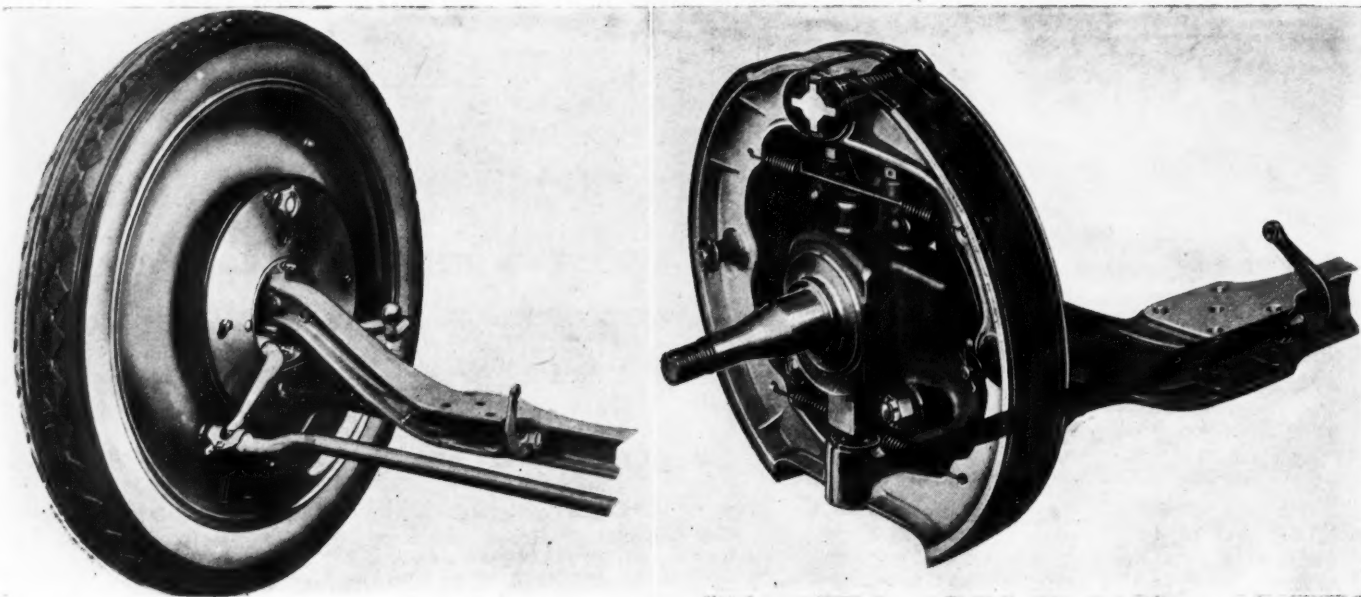


Fig. 16—Two views of Rickenbacker front wheel brake showing adjusting wedge at anchorage, phantom of rhomboid, cam, etc.

line of the king pin passes through the center line of the cam bearing, so that there is no motion tending to apply the brakes when the front wheels are turned in steering.

Locking Wheels Practically Impossible

The cam face is said to be shaped in such a way that as the knuckle is turned the effectiveness of the front-wheel brake decreases, making it practically impossible to lock the front wheels while they are turned and consequently virtually eliminating the danger of losing the ability to steer the car.

All of the brakes are adjusted for wear by wedges which control the position of the anchorage. The wedges fit into slots cut in the pivot pins. These wedges are drawn in by turning of the adjusting nut, thus forcing the pivots apart. Six notches are milled in the threaded section of the adjusting nut and a steel ball actuated by a spring snaps into each slot as the nut is turned.

It is possible to take up one or two notches as desired on each of the four wheel brakes with the assurance that an equal adjustment has been made. Contrary to usual practice, the pull rods are never touched except when assembling the brakes at the factory or when a

new lining is being installed. In the latter case the expanding wedge is backed all the way off and the rods adjusted to the new condition, after which the only adjustment necessary is that made by the adjusting nuts.

To provide against water being retained under any circumstances in the brakes, drain holes are drilled at several points around the drum. These holes are countersunk on the inside to avoid rough edges which might catch the frictional material.

Alemite attachments are provided for lubrication of the brake camshaft bearings. The brake cam bearing surfaces are lubricated by the drip from the knuckle pivot pin bearings located directly over the brake cam.

Method of Eliminating Shoe Rattle

To eliminate the rattle which might occur through transverse slapping of the shoe inside the drum, the shoes on all four wheels are held transversely between coil springs threaded over a bolt which passes through the brake housing and the web of the brake shoe. The same cam and follower assembly with the rhomboid equalizing block as are used in the front-wheel brakes are used also in the rear.

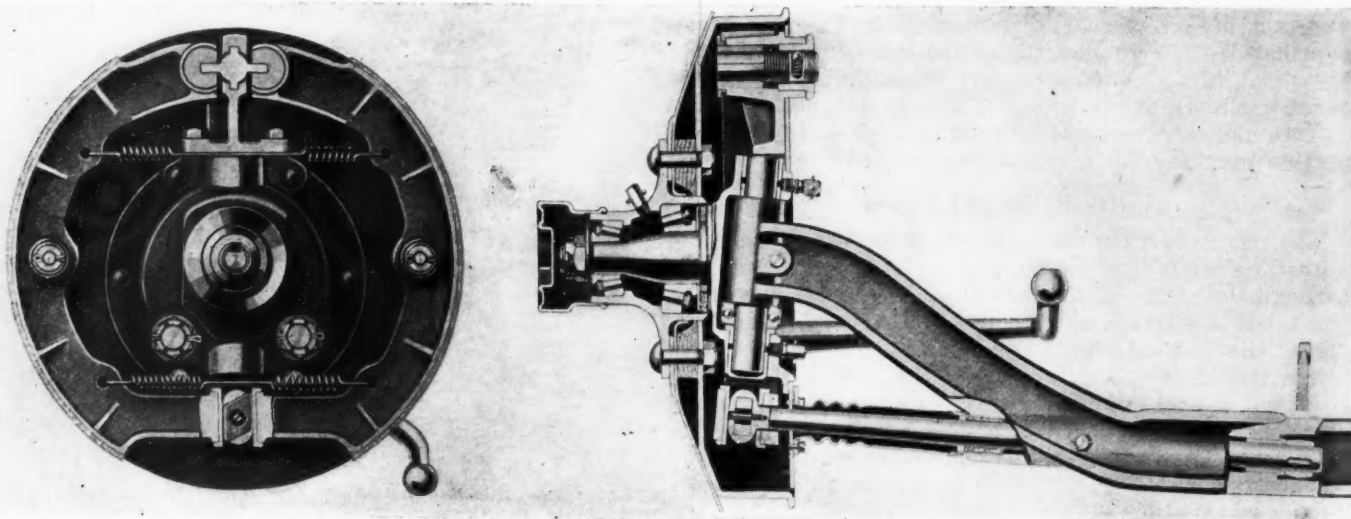


Fig. 17—End view and vertical section of Rickenbacker front wheel brake and axle, showing shape and arrangement of the floating cam and camshaft

Experiments Indicate Possibilities of Large Section Tires

Advantages of balloon type pneumatic are numerous. Great activity displayed in connection with its development. Several manufacturers considering its adoption as original equipment. Recognition must be given to limitations involved.

By S. P. Thacher

Technical Assistant to the President, United States Tire Co.

SOME time ago the United States Tire Company announced the development of a thin carcass, large section pneumatic tire of cord construction. Since then, there has been very great activity in the tire field in connection with the development of this type. It has reached the point where automobile engineers are becoming very much interested in it and, as a matter of fact, are seriously considering the adoption of such a tire as original equipment.

In view of this situation an authoritative

summary of the reasons for the development of the tire and some of its characteristics should be made, because there is no doubt, at least in the mind of the writer, that while this type has very definite features to recommend it, there are, on the other hand, certain limitations which must be recognized. When the announcement was made originally, it was stated definitely that the new tire was being described only as a matter of interest and that it was not ready for the market.

THE function of the pneumatic tire is to serve as a rolling cushion and to render this service economically. The ideal passenger car, from the standpoint of passenger comfort, would be one whose body travelled in a nearly horizontal plane without any vertical, horizontal or torsional vibration or sway. If automobiles ran on rails there would be no need for other than steel tires, and the spring suspension could be rudimentary. Road inequalities, large and small, have to be negotiated, however, and, to prevent excessive vertical movement in passing over them, efficient springing has been developed which neutralizes, to a large degree, the major road inequalities.

Shock absorbers and rebound snubbers must be considered part of the spring suspension system.

Springs, however, are not sensitive enough and, therefore, cannot act quickly enough to absorb the minor road shocks and at the same time compensate for the major inequalities, so these are left to the tires, which, in the pneumatic type, form the most efficient rolling cushions yet developed, although at high inflation pressures they are not all that could be desired.

The various steps in tire development, so far as sizes are concerned, have been made, as a rule, to accommodate the tire to the changes in automobile design, and the



Fig. 1—Comparative sectional views of a 33 x 5 in. tire and one of the new "balloon" tires, 34 x 7 in.

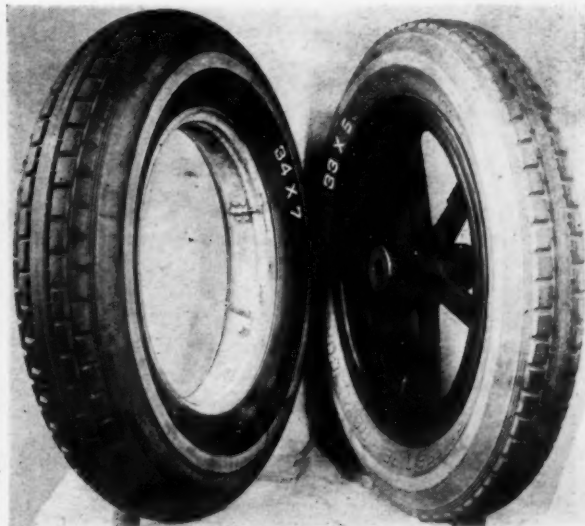


Fig. 2—Comparative perspective views of the same two tires as shown in Fig. 1

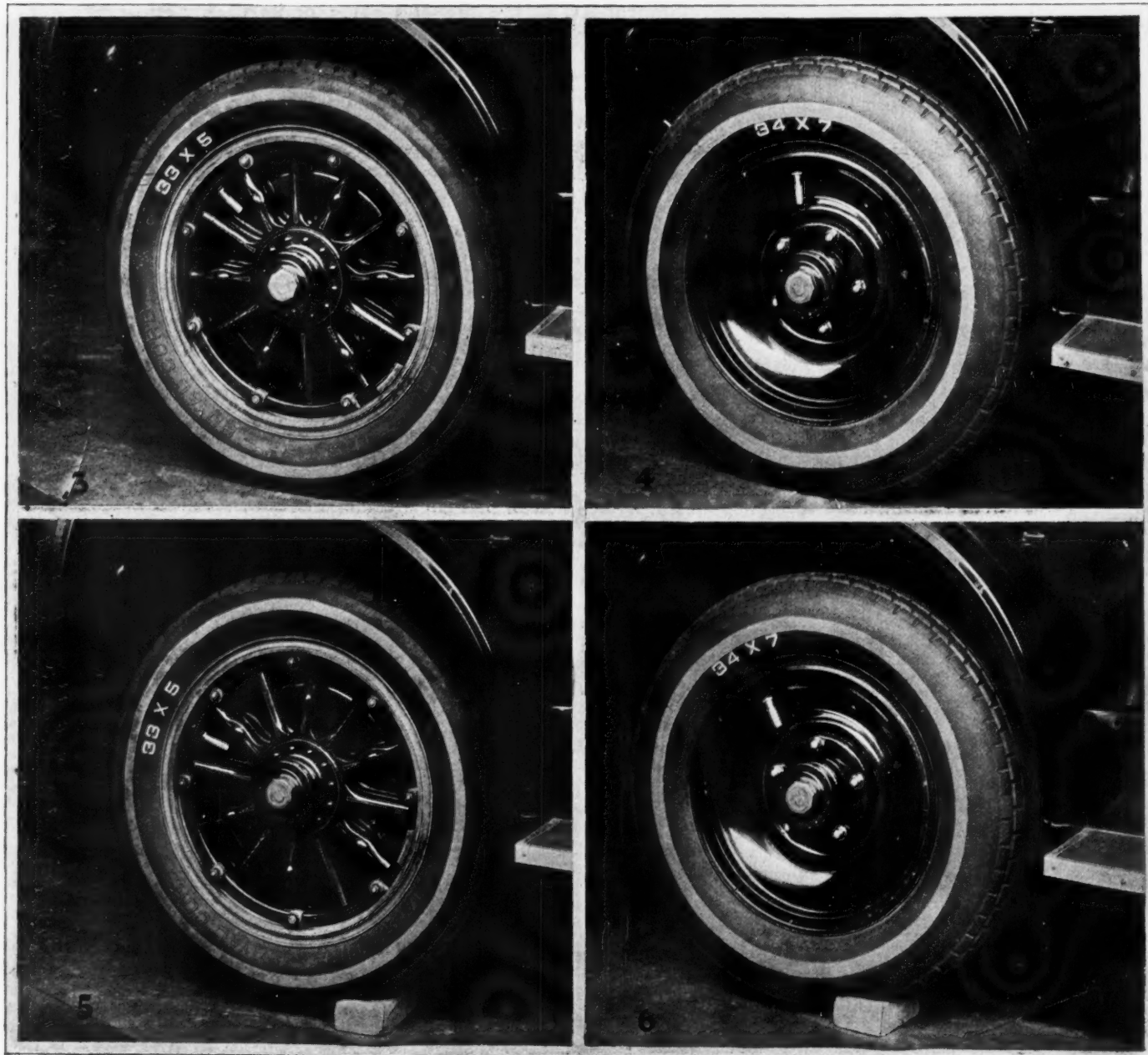
present development of the "super-pneumatic" is really the first radical change in tire sizes that has *not* been brought about by vehicle design. When studying the causes of and reasons for this new development it is interesting to recall the 42 x 4 and 42 x 4½ in. tires because the vehicle engineers, by using such large diameters, hoped to improve riding quality, and that is the result so ideally achieved by the "super-pneumatic." Those old high tires were supposed to "smooth the road" by bridging holes. These new large section, thin tires "smooth the road" by "swallowing" small road projections and obstacles.

The old saying, "You cannot have your cake and eat it, too," applies particularly well to pneumatic tires. Many features of the present type of tire can be improved, but only at the expense of some other features. For example, it would be a very simple matter to render a casing unpuncturable, but its flexibility would be decreased and the tire would wear itself out from internal friction too soon. Similarly, it is possible to design and compound a tread that will wear twice as long as those now in vogue. If

this were done the "balance" between carcass and tread would be destroyed and the casing, as a whole, would not deliver as much mileage as before, because the present carcass is as efficient as it can be made with our present knowledge of the art.

The super-pneumatic or, "balloon" tire, is a fair illustration of the compromise principle set forth in the last paragraph. This new and radical development has been brought about by a call for better cushioning of motor cars. The development of spring suspensions has been carried to the point where further progress seems impractical.

The development of this type of tire began in the fall of 1919 in connection with a well-known light car which was equipped with 4-in. cord tires. The first "balloon" tires to be used on this car were 4½-in. two-ply cord tires. Remarkably good results were obtained, with the one exception of ease of puncture. The lower inflation pressures made possible by the larger, thinner tire gave very much improved riding qualities. The program also included a line of thin carcass tires based on a 16-in. rim



Figs. 3, 4, 5 and 6—Comparative cushioning qualities and deformation of "balloon" and ordinary cord tires is shown in these illustrations



Fig. 7—This is what a balloon tire looks like when it is deflated. Note angle to which car is tilted.

diameter, but upon the commercializing of the bus and truck tires based on a 20-in. rim diameter, we, for the time, gave preference to "balloon" tires on this latter rim.

The cushioning effect of a pneumatic tire under a given load is inversely proportional to its inflation pressure. If you can lower the pressure you can gain ease of riding. But the present line of tires cannot be operated at a low enough inflation to give *extreme* cushioning for two reasons—first, because the resulting increase in flexing would quickly wear out the tire carcass and, second, because the tires would steer hard and consume too much power. Therefore, our problem was to design a tire that would operate at below half the usual inflation and not drag, steer hard, or wear itself out internally. The only and obvious solution was to increase the sectional area to the point where a much thinner and more flexible carcass could be used and where the unit inflation pressure would be at the desired minimum, but still hold the casing out to shape under the rated load. The problem is comparable to lifting a given load on a piston by means of compressed air. Double the piston area and you can lift the same load with half the unit air pressure.

Relative Contact Area of Various Tires

Among the mass of technical and semi-technical articles which have appeared in trade journals during the past few months on this general subject there is one outstanding error commonly found—namely, the statement that since the pneumatic tire balances a given load on its compressed air content any pneumatic tire will deflect until its contact area on the road equals the load supported divided by the inflation pressure per square inch. As a matter of fact, this is far from being true in the case of non-skid cord tires however thin they may

be made. For example, a certain make of 33 x 5-in. eight-ply cord tire when loaded to 1700 lb. at an inflation pressure of 65 lb. per square inch will give an area of tread contact of 15.8 sq. in., or an average tread pressure, if I may use such an expression, of 108 lb. per square inch. A 34 x 7-in. four-ply "balloon" tire of this same make, under the same load and at the same inflation pressure will give a total area of tread contact of 15.75 sq. in., or approximately the same as in the case of the eight-ply 5-in. tire. Both of these tires have essentially the same non-skid tread configuration at the crown of the tire and the explanation of the variations of these results from what would be predicted theoretically is to be found in the non-skid tread and the stresses it sets up in the carcass above and near the road contact area.

On the other hand a 32 x 6-in. four-ply cord airplane tire when loaded to 1200 lb. and with an inflation pressure of 60 lb. per square inch gives a total area of tread contact of 19.8 sq. in., or an average tread pressure per sq. in. of 16.6 lb. Here we are approaching the theoretical condition, but this tire is not only thin in carcass, but has a very thin, round, smooth tread.

The flexing of a pneumatic tire in service consumes a certain portion of the motive power of the car and the design, construction and inflation pressure of the tire have a very marked effect on this power loss.

In the development of the "balloon" tire it has been proposed to substitute a 34 x 7-in. thin tire for a 33 x 5-in. relatively thick tire, and certain tire manufacturers have recommended operating these 34 x 7-in. tires at an inflation pressure of approximately 30 lb. per square inch. Very accurate power consumption tests made on an electric cradle dynamometer, indicate that in a 33 x 5-in. eight-ply cord tire running at 25 m.p.h. under the present standard load of 1700 lb. and standard inflation pressure

of 65 lb. per square inch, the tire loss is 0.71 hp., while a 34 x 7-in. four-ply tire at 30 lb. inflation pressure consumes 0.94 hp. and 0.72 hp. at 45 lb. inflation pressure.

This clearly indicates that if the "balloon" tire is operated at the recommended pressure the car will use more gasoline to cover a given mileage and will lose some of its driving characteristics. This latter is quite clearly demonstrated when a car which has been running on 5-in. cords is changed over to these 7-in. "balloon" tires. There is a noticeable loss in pick-up and in hill climbing ability. If the inflation pressure is increased to 40 or 45 lb. the car regains most of its former characteristics except that the effect of the larger diameter of the tire is felt to a certain small degree. The comparative sectional size and construction of these two tires is clearly seen in Figs. 1 and 2.

The tractive and braking effects obtained with the "super-pneumatic" are more satisfactory than with the present type of tire. The reason is, of course, found in the larger number of tread projections presented by the larger, softer tires. Non-skid qualities are also much better, and for the same reason.

Figs. 3, 4, 5 and 6 furnish better evidence of the improved cushioning qualities of the "super-pneumatic" than all the scientific data obtainable. They show a 33 x 5-in. and a 34 x 7-in. tire at rest, and striking a brick at 6 m.p.h. on the rear wheels of a Cadillac coupe. Note how the 34 x 7-in. "swallows" the brick while the 33 x 5-in. rides on it and on the ground. Figs. 4 and 5 show that the low inflation pressure of 30 lb. per square inch in the 34 x 7-in. tire does not produce a "flat tire" since there is no more appreciable bulging at the road contact than in the 33 x 5 in. The "balloon" tire completely does away with vibrations due to smaller inequalities such, for example, as cobble stones and bricks. In these types of pavement the "texture" is not felt but the hollows and projections due to the uneven laying of the cobbles and bricks are noticeable, although the blows are, of course, considerably softened by the large, thin tires.

Fig. 7 gives a very good illustration of what a 34 x 7-in. "balloon" tire looks like when it is deflated and the extent to which the car tilts. Nobody has ever seen a flat tire until they have seen a deflated "balloon" tire and the result of a blow-out, when traveling at high speed, is not difficult to imagine.

Certain cars have an inherent tendency to "weave" at high speeds. "Balloon" tires on such cars will increase this tendency and will, on other cars, cause slight "weaving" at excessive speeds on certain types of road surface.

Another peculiar characteristic is that, at excessive speeds, the effect of centrifugal force on this large section, thin tire is to periodically deform it into a higher, narrower sectional shape and to produce a peculiar vertical wave motion in the car.

High speed also seems to increase the puncture hazard, while at normal speeds the "balloon" tire does not appear to pick up any more nails, tacks, pins, etc., than the present type.

Must Speed Be Sacrificed for Cushioning?

Here, then, we have the other phase of the compromise referred to in a previous paragraph. Apparently we must sacrifice excessive speed to gain comfort and this would seem to limit the "balloon" tires to city work or to country driving on paved roads where speed is not a factor.

Furthermore, it is open to question whether extreme cushioning is worth what it will cost in the way of automobile design if it is carried to the extreme. We know that a 34 x 9-in. tire will carry the same load as a 34 x 7-in. at a considerably lower inflation pressure and therefore will give still better cushioning effects. This tire would be mounted on a 16-in. diameter rim and its use would necessitate changes in rear axle and brake design, as well as in front width of chassis. In our opinion the full possibilities of this development should be exhausted before 20-in. rim diameter tires are seriously considered by vehicle manufacturers. There is no question but that the field of usefulness of these large section, thin tires is limited and, therefore, it appears unwise to urge their adoption until they have been thoroughly tested by automobile manufacturers over a longer period than has yet been done.

The most serious consideration should be given to the economic aspects of the rapid commercializing of the "balloon" tire. From the tire manufacturing standpoint it would result in materially reducing the productive capacity of all factories since the "balloon" tire is considerably larger than the tire it is designed to replace and therefore fewer tires can be vulcanized in a given size of unit. This would be reflected in the costs.

Standardization of Wood Screws Reported by Standards Bureau

BUREAU of Standards Circular No. 140, which has just been issued, deals with the work which has been carried out by the Federal Specifications Board on the standardization of wood screws, and the standards set forth in this circular will be used in all future Government purchases.

At least two systems of numbering wood screws to designate the diameter have been used in the past; methods of measuring lengths have been hopelessly at variance; and the number of threads per inch for a given size has not been the same for different makes.

All this confusion has been eliminated and the dimensions of wood screws made uniform throughout the United States as the result of a cooperative agreement among the manufacturers, the Bureau of Standards, and the technical section on builders' hardware of the Federal Specifications Board.

The system of numbering to be used henceforth is the same as that now employed in designating machine screw sizes, except that diameters above No. 12 are also designated by numbers.

Uniform methods of measuring diameter and length and uniform tolerances in these dimensions were adopted together with a standard angle for the under side of the heads of flat and oval head screws. The number of sizes of brass and steel screws manufactured as standard was reduced from 555 to 291, a reduction of 47 per cent, while at the same time retaining a sufficient variety for every need. This reduction should benefit the manufacturer, the dealer, and the user.

DIFFICULTY has been found in measuring the Brinell hardness of steel having a hardness over 500 B.h.n. An attempt has been made by the Bureau of Standards for the past 3 or 4 years to obtain a steel which will carry the load of 3000 kg. without fracture.

Tungsten carbide has been suggested, but it has been impossible to obtain this material in suitable condition in either this country or Germany. Recently a very hard vanadium steel made at the Bureau's laboratories has been tried and shows promise of success.

Safety and Comfort Chief Factors in Motor Coach Design

Operating economy of secondary importance. Lower frame, wider tread and finer body, desirable characteristics for future models. Better provisions for driver are needed. Application of Diesel principle to automotive work worth careful study.

By Frank R. Fageol

General Manager, Fageol Motors Co.

THE coach of today, and the better coach that will come in the future, must be engineered to meet the merchandising problem of the operator, which is the selling of more rides, the broadening of the service that the bus is able to render.

In accomplishing this end, safety, comfort and convenience are primary qualities of the bus of today and tomorrow. Speed is important only as it is related to comfort and safety. Operating economy is of secondary importance only.

Many operators, and most manufacturers, will question the above statement. Let me remind them that candles cost less than electric lights. Teakettles are less expensive than automatic water heaters. No business man thinks that it costs less to drive to work in his automobile than to ride on the street car. The compelling motive here is the desire for convenience, or stated conversely, the disinclination to tolerate inconvenience, which, after all, is the main reason for the existence of the motor bus. No person ever rode in a bus because it was operated for a cent per mile more or less than some other bus. Every day thousands of people are riding in some buses rather than in others, because the one that they choose is more to their liking from the personal standpoint of convenience, comfort, refinement and safety.

Variable and Fixed Charges

Consider further that 60 per cent of the cost of conducting a bus or coach business is made up of the items that go in the balance sheet as "fixed charges," which includes salaries, rent, advertising, interest, etc., which charges would be the same with vehicles of a certain capacity, regardless of who makes them or what they are made of. The remainder of the cost of conducting the business consists of the items which vary with different buses—gasoline, oil, tires, repairs, and depreciation. It is conceivable that one make of bus could operate at a saving of 20 per cent of the "variable charges" as compared with the average. But suppose that it did—diluting this saving with the "fixed charges," the net result is only an 8 per cent gain.

Now suppose that two different makes of bus operate at the same cost per mile, but that one is a clumsy, lumbering, high, trucky vehicle, while the other is a comfortable, smooth running, easy riding, richly finished, low, safe bus. Obviously, more people would be willing to ride in the latter type of vehicle, hence the revenue derived from its operation would be greater, operating under like conditions. Suppose this difference were only 10 per cent. Your own judgment will tell you that this

is a conservative estimate. Or, if you desire corroborative evidence I refer you to the Pullman Company, which has demonstrated this principle, not in one, or in ten small communities, but on an international scale. Remember, we are supposing a case in which the remodeled truck and the dyed-in-the-wool passenger bus operate at the same cost. If the passenger truck shows a net operating profit of 8 per cent the man who operates the car that is more in the public favor will have 18 per cent profit, due to the 10 per cent increase in revenues. Many operators who have used both types of bus say that the use of the new type has increased their revenue 25 per cent, or more.

Problem to Keep Cost Down

Thus we see that the problem of the bus engineer is to strike the proper combination of features that keep the cost down and bring the amount of revenue up, to produce the maximum net profits for the operator. He must ascertain what the public is willing to pay the most fares for, and build that. This makes his problem distinct from that of the truck engineer.

The foundation of the coach, the chassis, must be engineered in its relation to the prospective rider, and as it is affected by present and future highway conditions. Convenience and safety in boarding or alighting demand the elimination of the "step ladder effort," which is accomplished in the modern coach by building the frame close to the ground, and in such a manner that the floor of the body can be built flat on the frame, without intervening sills of appreciable thickness. The low frame is made possible by constructing a "kickup" over the rear axle, a "goose-neck" over the front axle, and using under-slung construction on springs, propeller shaft, etc. This type of construction is sound from another angle of safety also, in that it brings the center of gravity very low, and greatly lessens the danger of overturning in case it is necessary, for any reason, to turn a sharp corner at a high speed. Inasmuch as most buses are now operating over hard surfaced roads and the mileage of these improved roads is rapidly increasing, it is possible to build large capacity coaches capable of being operated in or between practically all centers of population of sufficient density to afford a profitable revenue, with floor levels as low as 20 in. from the ground.

Riding Comfort from Low Construction

Riding comfort is also increased by this low type of construction. Obviously, the ideal position for most comfortable riding would be on a line drawn from the center of the front axle to the center of the rear axle,

and the more nearly this ideal riding position can be approximated, the less will the unevenness of the road be transmitted to the passenger in the form of side sway and pitching about. Low construction has made bus riders out of thousands of timid people.

Bearing in mind that we are trying to create a vehicle which will attract more passengers, let us consider another feature which has to do with this convenience, comfort and safety—a wider tread than has been the accepted rule in building motor vehicles. The convenience of the lower frame is more readily achieved if the distance between the wheels, especially at the rear, is increased, so the body may be set down between the wheels instead of being perched above.

Wide Tread Increases Safety Factor

For the same reason that an automobile with a long wheelbase is more comfortable than its little brother that has the 100-in. dimensions between the front and rear tires, the coach with a wide tread is more comfortable to ride in than one with the standard 56-in. tread. The safety factor is also increased by placing the wheels farther apart and giving the vehicle a broader base on which to rest.

The survival of the 56-in. tread seems to be one of the interesting but useless heritages from the horse-drawn age, anyway, which will probably pass into oblivion in this country, along with the right-hand drive. It is easy to understand why the first motor cars were built the same width as the buggies and wagons of a generation ago, for those were dirt road days, and dirt roads in most parts of the country had ruts. Automobiles were built in those days to follow in the track of their predecessors. The width of the highways on which they run, and the density of the traffic, will be the controlling factors of width of motor coaches, once the idea of the conventional 56-in. tread for high-speed vehicles passes into the discard, where, for safety's sake, it rightfully belongs.

So much for the chassis—now for the body, which has received a great deal more attention at the hands of bus engineers and operators.

Ultimate Consumer's Needs

Picture again the "ultimate consumer" and his needs and desires. There are, and in all probability will be in the future, two general types of bus, each suitable only for its definite work in the transportation scheme—city or inter-city travel. The increasing efficiency of the age points toward a large capacity vehicle with a body of the street car type, operated by one man. To facilitate handling in dense traffic the logical development seems to be, where climatic conditions make it feasible, a double decker with no roof over the upper deck. Inclosed upper decks will come where there is no interference from overhead trolleys.

There are a number of good and very practical single deck city type bodies available today, which, adapted to real bus chassis, seem to be good enough in design to persist with the refinements and modifications that will develop with more extended experience.

For inter-city travel the inclosed body, with full width across seats, seems to be in the ascendancy, for the same reasons that the coupe and sedan are with us in such rapidly increasing numbers—convenience and comfort. Coaches are now made and used that are comfortable under any climatic conditions—entirely closed, heated, and ventilated in cold weather, and sides all open to the breezes in hot weather. The day of fine finish and easy cleaning is with us, and a new era of super luxury is just around the corner. There will be different degrees

of luxury offered at varying fares on all the main bus lines, just as there are now several classes of Pullman accommodations, extra fare trains, etc., or just as there are several grades of hotels. It is all a matter of supplying the degree of luxury for which the patrons are willing to pay.

More attention will be paid in the future to lessening the strain on the driver of the coach with its load of human lives. It is a man's job to drive a 30-passenger bus under city traffic conditions, with ten to twenty stops per mile. The driver's energy must be conserved, that he may be clear-headed and vigorous to respond to emergencies. Power brakes on buses are just as inevitable as the air-brake system on trains or street cars. The heavier buses will no doubt be equipped with brakes on all four wheels, controlled by either air or fluid, so as to equalize the pressure on all four wheels, make the brake action smoother, and minimize skidding. Very creditable starts have already been made toward the development of such highly efficient brakes, which place almost no strain on the driver. It is also reasonable to expect that power steering apparatus will also be available for the handling of the heavier units.

Ideal Construction Yet to Come

The ultimate size of the motor bus is a thing at which we can only guess at this time. Some day in the not distant future we can expect to establish the size at which it will not be economical from an operating standpoint to continue enlarging, but operators seem to want to increase the capacity of their rigs to the capacity of the highway. The findings of the traffic expert and the man with the alert ear for public opinion may step in and relieve the engineer of this task, however.

The possible motive power of the future is always an interesting speculation from the engineering standpoint. Very satisfactory gasoline driven motors are available—they can, and no doubt will be improved in the course of time in response to the demands of operators who are coming to realize that it costs \$40 or \$50 a day to lay a bus up in the shop. More durable parts and units designed to permit quicker replacement, are making their appearance, and the future will see much thought and study on the same line.

Still, we have no assurance that gasoline will be our fuel forever. Steam, or the application of the Diesel principle to automotive propulsion have possibilities worthy of careful study.

While the ultimate ideal in motor bus construction has probably not yet arrived, rapid strides have been made during the past two years, and standardization, at least in general type, is already in sight.

ALTHOUGH four American motorcycles are represented in the Austrian markets, says Trade Commissioner William Ford Upson, Vienna, in a report to the Commerce Department, they were not exhibited at the first motorcycle exhibit in Vienna which was held from March 31 to April 8, and which attracted extraordinary public interest.

Both heavy and light machines were shown; the former type was displayed by seven German, two Italian, one Swiss, and one Belgian firm, while three Austrian and fourteen German firms exhibited light motorcycles of various models.

American machines were not shown owing to the fact that the representatives had none in stock, and their absence at the exhibition was keenly regretted by automotive interests as their high quality and general superiority are well known.

Light Alloys Play Prominent Part in Recent Piston Design Development

IN the thirty-one pages immediately following, Automotive Industries presents for the information of engineers and designers a series of mechanical drawings showing some of the recent developments in pistons, front axles, clutches, tire carriers, spring suspensions, steering wheels and combustion chambers. They are assembled to give them greater reference value.

GRADUAL development rather than revolutionary change has been apparent in piston design for the past year. The various types of cast iron and light alloy pistons which are illustrated on the following pages show no great departure from recent customary practice. Substitution in several cases of light alloy in place of cast iron for piston material constitutes the most outstanding change at this time.

The development work which has centered on the light alloy piston has affected the design of the cast iron type in several ways. This effect is demonstrated by the improvements now apparent in the latter type, chief among which are lighter weight and better disposition of metal as a thermal agent.

Mechanical strength and limitations of foundry practice are no longer determining factors in design of piston head or ring portion of the skirt. Attention has been directed to the need of a certain volume or depth of metal to provide adequate thermal capacity or ability to carry heat away from the center of the piston head.

Experience has shown that the volume of cast iron required as a thermal agent is greater than the amount necessary for strength alone. In many cases a bad knock has been eliminated by increasing the thickness of the head.

GENERAL practice now allows a rather liberal thickness inside of the rings, as the need for thermal capacity at this point has been rather thoroughly demonstrated. In fact, many engineers now hold the opinion that the greater share of the heat which is radiated from the piston head is dissipated at the rings. Referring for the moment to aluminum piston practice, the value of this opinion is demonstrated by the commercial success of pistons which are made so that the head portion is almost or entirely separated from the skirt at a point just below the lower ring.

As a result of this same opinion the fit of piston rings in their grooves has taken on a greater importance. It is essential that the sides of rings and grooves be square and form a joint with a maximum area of contact. A gradual trend toward narrow piston rings is apparent.

Aluminum or light alloy piston designs, shown on the following pages, indicate that the tendency to use very thin sections with these metals has disappeared. It was this very tendency which first opened up the question of thermal capacity and its greater importance as related to mechanical strength.

The use of thick head sections and the gradual reduction of section toward the bottom are now almost universal with producers of light alloy pistons.

The question of skirt expansion with resultant scoring and seizing or, rather, the choice between this trouble and piston slap incidental to excessive clearances, is apparently eliminated. Insulation against the direct flow of high temperature from the head has greatly reduced the former troublesome expansion of the skirt.

CLEARANCE between the piston and cylinder bore is very small and is no greater than that specified when cast iron forms the piston material. In every case in which this small clearance is used the skirt is insulated against direct convection from the head by a wide slot just below and parallel to the lower ring. In the majority of cases this slot is placed only in the lateral bearing surfaces; some designs, however, extend the slot entirely around the skirt. The ends of the shorter slot usually extend into the liberal relief areas surrounding the piston pin bosses, isolating the skirt from practically all tendency to distort or expand as a result of the great heat at the head.

Much attention has been given to relief at the pin ends, the general tendency being to carry the pin bosses in parallel ribs which join the skirt only at the lateral thrust surfaces.

A majority of users of light alloys cut a single narrow slot at a few degrees from vertical in slack side of the skirt, the slack side being the surface opposite the one which carries the thrust during the power stroke. One make, however, has diagonal slots cut in both lateral faces of the skirt and another has six vertical slots which are cut in the centers of the lateral faces and between the ends of the supporting ribs and the pin ends. Another maker casts in steel rings which control expansion of the skirt and places a narrow wavelike slot lengthwise of the slack side. A two-piece piston has the head separate from the skirt, which is of the slipper type, reinforced by steel struts.

OIL pumping has lost much of its plague-like aspect and seems to have entered the class of engineering details which can be controlled by better design founded upon experience.

The location of the free bearing of the piston pin seems to be an open question, depending upon the choice of the individual designer.

PISTONS—EXAMPLES OF RECENT DESIGN

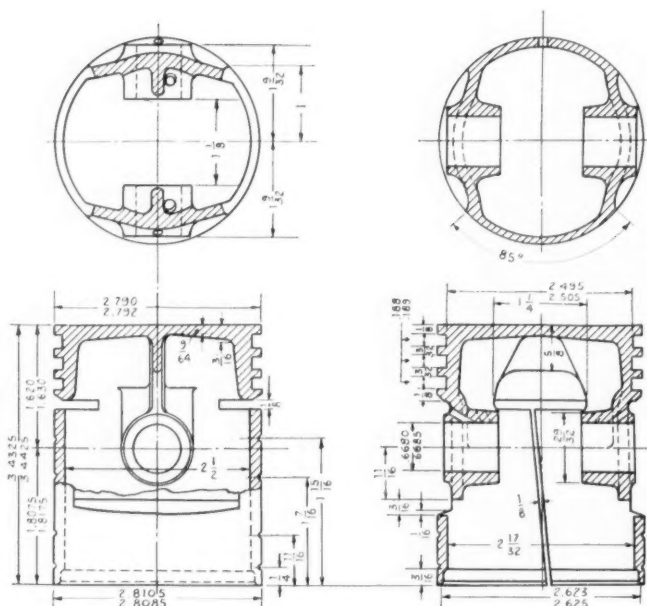


FIG. 1

CHALMERS

(Fig. 2)

Four cooling ribs support the head which is $\frac{5}{32}$ in. thick at center, increasing to $\frac{7}{32}$ in. at the circumference. Wide slots are placed in the lateral surfaces below three $\frac{1}{8}$ in. rings, also below the clearance at pin ends. Lateral bearing surface is about equally distributed above and below the pin center. Piston is made of light alloy.

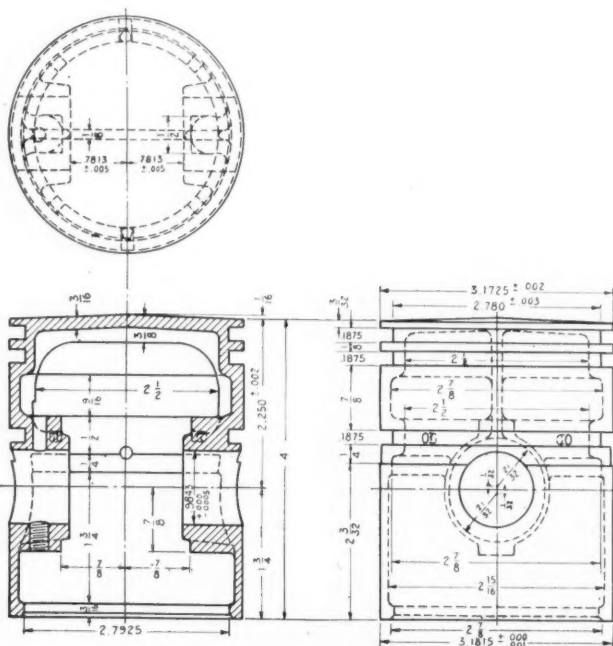


FIG. 3

OAKLAND

(Fig. 1)

Note relative sections, rather thick at the head, diminishing toward bottom of skirt. Lateral bearing surfaces are insulated from heat of the head by $\frac{1}{8}$ in. wide saw slots. Light alloy piston is assembled with clearance of .0025 in. The top ring is of the step cut, concentric type and the two lower rings are of the two piece, diagonal cut type. The saw slot lengthwise of the skirt compensates for the relatively greater expansion of the aluminum alloy piston and permits close fitting. Design of pin bearing supports is analogous to a cross-head construction.

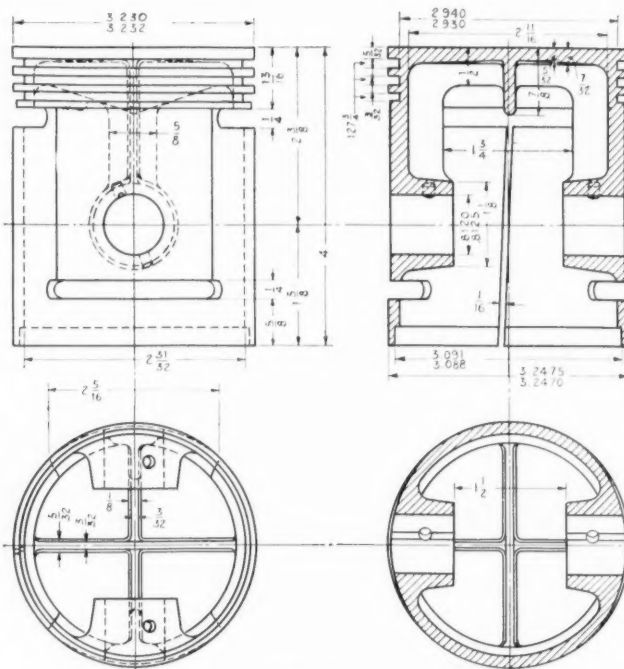


FIG. 2

REO SIX

(Fig. 3)

A barrel type of light alloy piston of moderate section having two $\frac{3}{16}$ in. wide rings placed at the top and a scraper ring in a drilled groove, $\frac{7}{8}$ in. below the second ring. A clearance ring $\frac{1}{4}$ in. wide which is just below the scraper ring intersects the pin bearing bores and thus provides lubrication for the upper rod bearing. The barrel is ground to .005-.006 in. clearance to the lower edge of the second ring groove.

PISTONS—EXAMPLES OF RECENT DESIGN

HUPMOBILE (*Fig. 4*)

Four $\frac{1}{8}$ in. wide rings are used in this light alloy design which incorporates a thick head section and a thin split skirt which is cut away below the rings and pin ends. Pin bosses are carried in heavy parallel ribs which are dependent from the head portion. The projected width of the lateral bearing surfaces is $1\frac{1}{2}$ in. Opposed scraper grooves are cut in the skirt above and below the pin which is set just above the center of the bearing area. A clearance of .002-.004 in. is specified in this case.

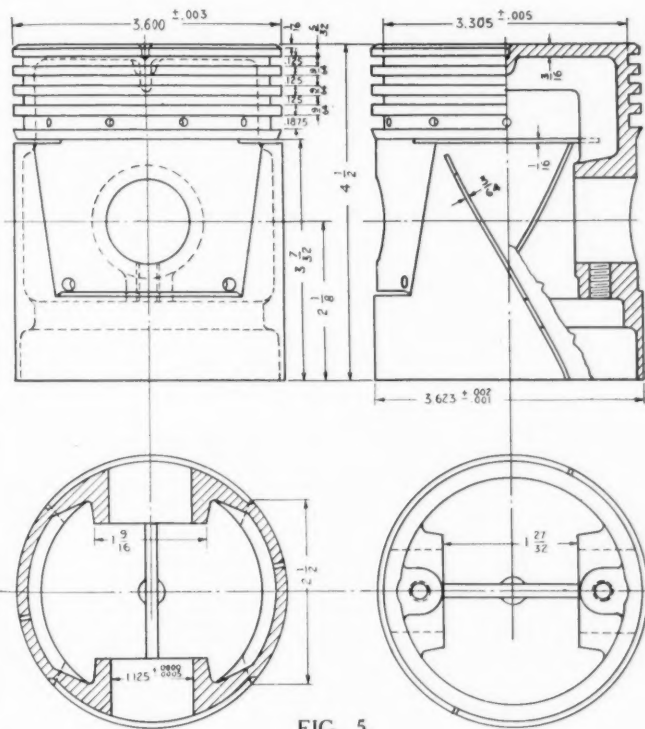


FIG. 5

CHEVROLET COPPER-COOLED (Fig. 6)

A very simple light alloy design used in the air-cooled model and an example of the trend toward gradual decrease of section from head to base. The skirt is slit through 100 deg. on the pressure sides below the lower ring to prevent radiation from the head. Bearing is made in the cylinders through 70 deg. on both lateral surfaces, the remainder of the circumference adjacent to the pin ends being .020-.025 in. under size. Pin bearings are oiled by drilled holes from the relief groove.

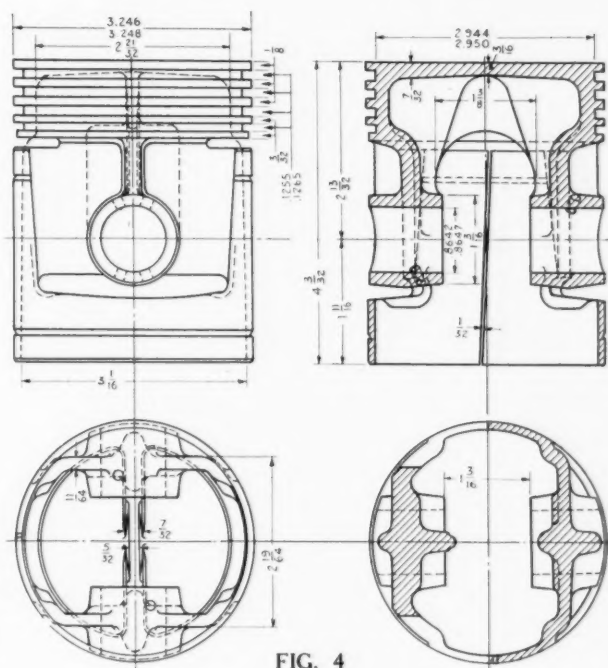


FIG. 4

HAYNES (*Fig. 5*)

Diagonal saw slots are cut in both lateral faces of light alloy design. Pin bearing bosses are not separated from wall of skirt. The head is supported by a single deep rib ending in the pin bosses and acting as a convection medium.

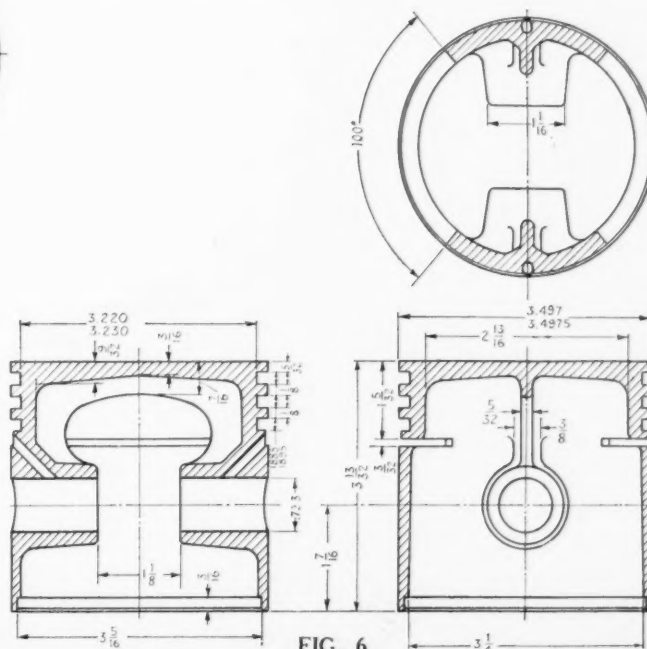
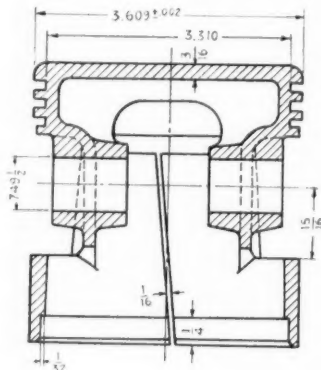
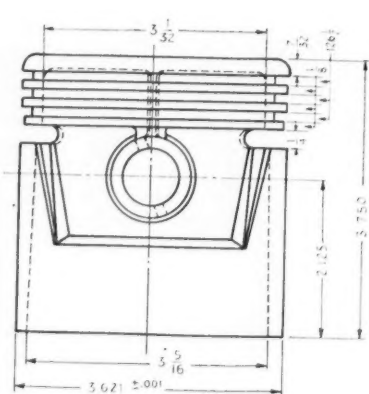


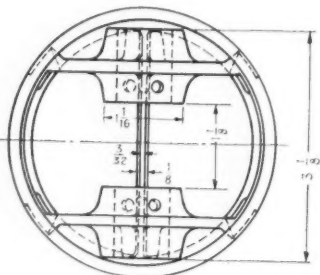
FIG. 6

PISTONS—EXAMPLES OF RECENT DESIGN



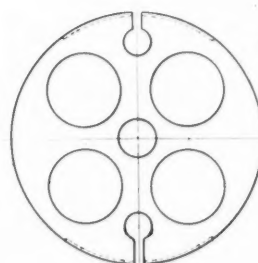
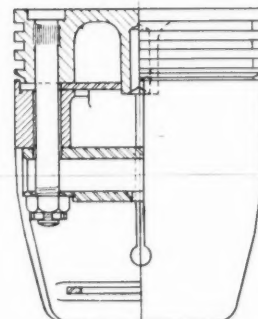
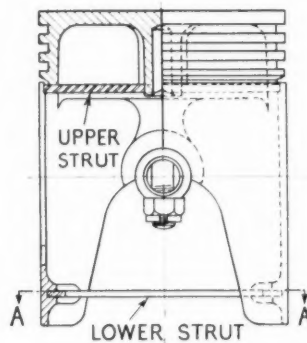
MAXWELL (Fig. 7)

The skirt of this light alloy piston is insulated from the heat of the head. Pin bearings are carried in parallel ribs. Characteristic slots below rings, pin ends and slit skirt are included in a design of generous sections. Three $\frac{1}{8}$ -in. wide rings are used.



NELSON (Fig. 8)

Light alloy design, in which head is insulated from the skirt by upper pressed-in steel strut. A lower cast-in steel strut also supports skirt. The struts are used to maintain a true cylindrical surface at the skirt. The downward extension at center of head provides additional radiating surface. A pair of bolts lock the piston structure together and retain piston pin. Note oil relief groove below lower ring.



UPPER STRUT

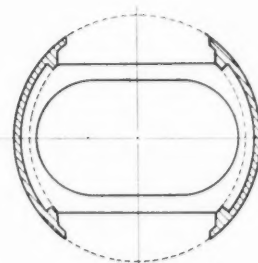
SECTION "A-A"
LOWER STRUT

FIG. 8

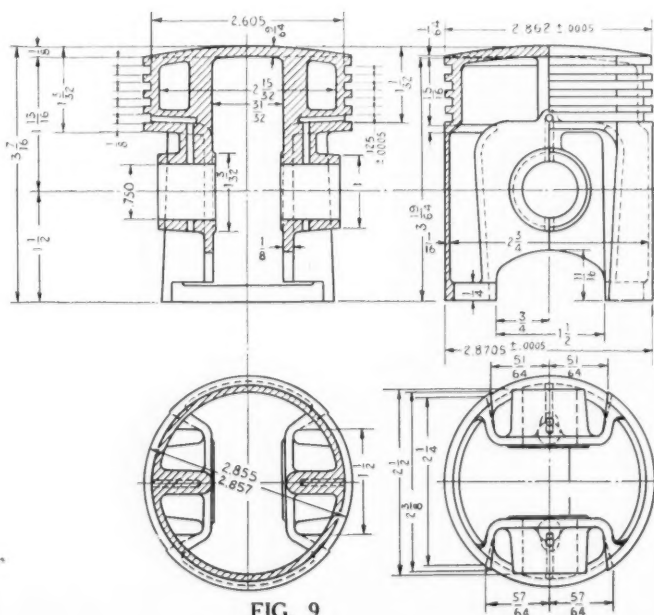
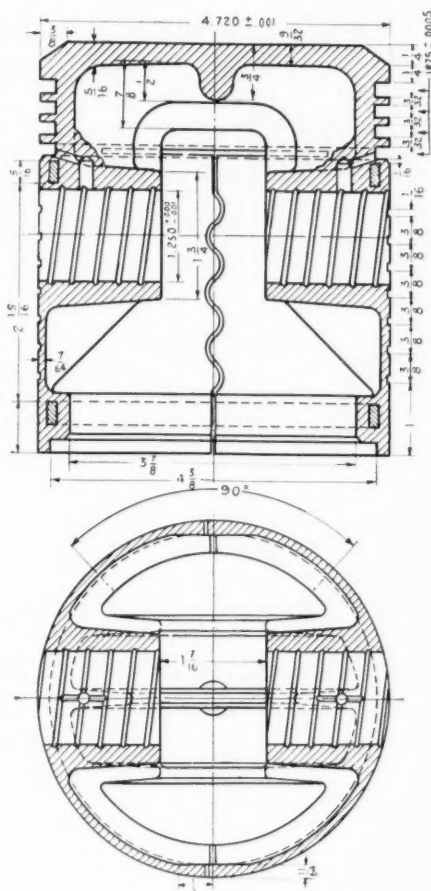


FIG. 9

DUESENBERG (Fig. 9)

Light alloy slipper type, the head is supported by parallel ribs. The supporting ribs are of circular cross section above pin bearings and below are of U-shaped section. A bearing of $2\frac{1}{4}$ to $2\frac{3}{8}$ -in. width is provided at each thrust surface and skirt is cut away at pin ends. Four $\frac{1}{8}$ -in. wide rings are located in the head portion and the full diameter skirt projects downward from edge of lowest ring. Piston pin bearings are oiled by holes drilled into the bottom of the lower ring groove.

PISTONS—EXAMPLES OF RECENT DESIGN



LOCOMOBILE
(Fig. 11)

A cast iron piston with large diameter and rather liberal sections. Threewiper grooves are placed near the bottom of the skirt and a tapered relief is turned just below the lower ring with eight drilled holes leading through the skirt in the fore and aft surfaces of the piston. An inner reinforcing belt and an outer oiling groove are located on the horizontal center line of the pin. The clearance is .0025 in. and the pin is placed slightly off center to prevent slap.

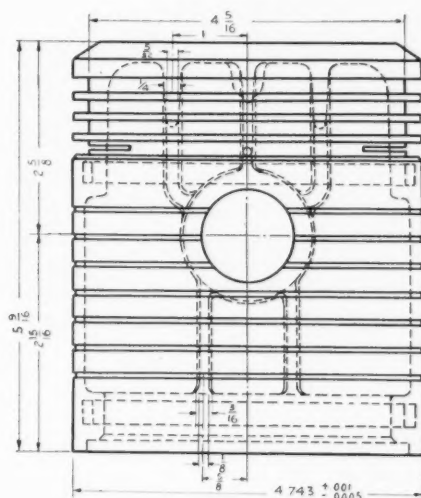


FIG. 10

MIDWEST
(Fig. 10)

Steel rings are cast in upper and lower ends of the skirt to limit rate of expansion. The lateral faces are insulated from the head by slots sawed in the bottom of the lower ring groove which also serve as the oil relief outlet. The skirt has a wavelike groove formed in the slack side. The head is reinforced and cooled by three heavy fore and aft ribs. Light alloy material is used.

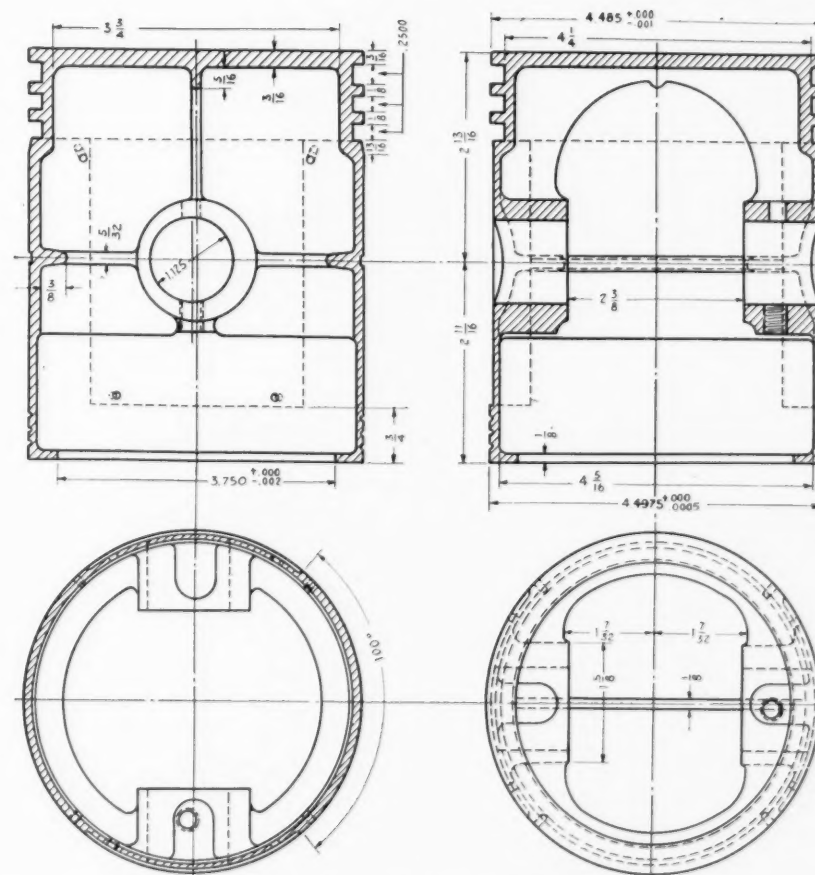


FIG. 11

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1

PISTONS—EXAMPLES OF RECENT DESIGN

HAYNES (Fig. 21)

Four rings, the lower installed in drilled groove, are carried at the head of a cast iron piston of moderate section. The skirt is of the barrel type with relief at the pin ends.

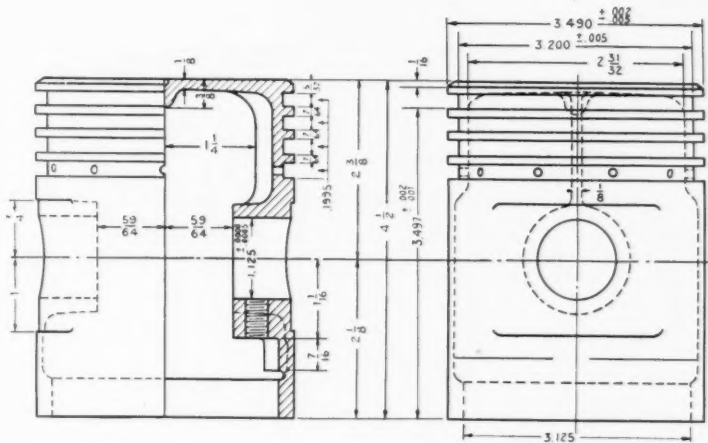
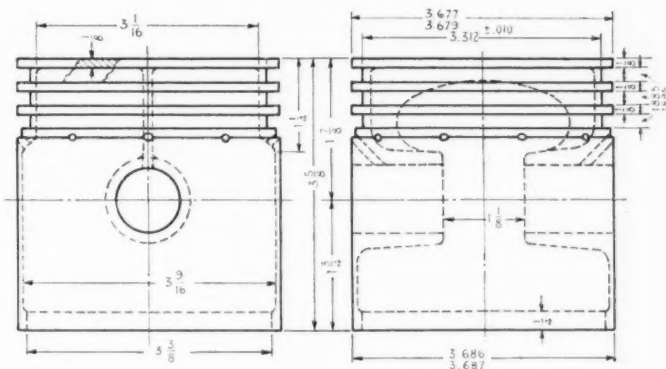


FIG. 21



CHEVROLET "SUPERIOR" (Fig. 22)

Thin sections throughout characterize this cast iron design. The head of $\frac{1}{8}$ in. thickness is supported by an arched fin ending in the pin bosses. Oil is directed to the pin bearings by two $\frac{1}{8}$ in. dia. drilled holes from a relief groove adjoining the lower ring. Eight additional $\frac{1}{8}$ in. holes are also drilled from the relief groove to convey excess oil to the inside of the skirt.

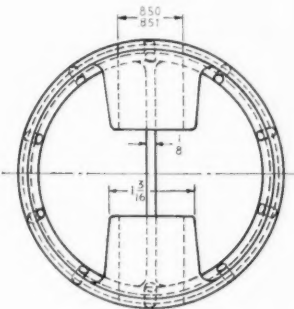


FIG. 22

WEIDELY (Fig. 23)

An inverted gutter is turned in the skirt in line with center of pin and acts as a scraper to provide oil for the upper connecting rod bearing. A narrow bevel land is turned at lower edge of the bottom ring groove and ten $\frac{1}{8}$ in. relief holes are drilled through skirt at that point. The thin head is domed and therefore requires but the single rib for reinforcement. Piston is cast iron.

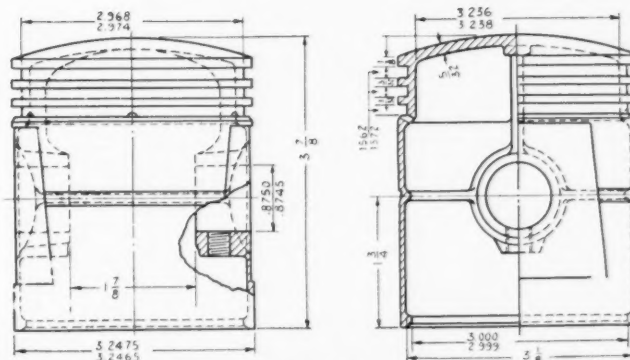


FIG. 23

NOVEL FRONT AXLES of FOREIGN DESIGN

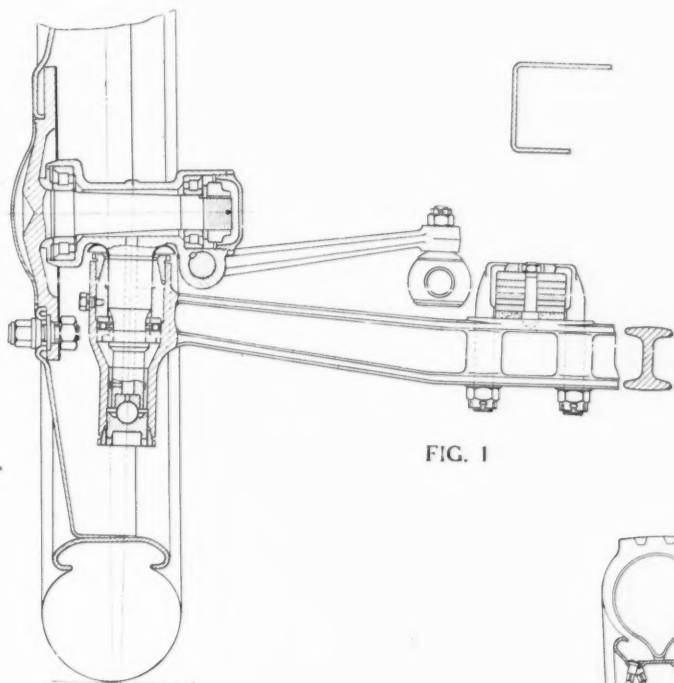


FIG. 1

PRIAMUS (Fig. 1)

A German front axle with live wheel spindle mounted in straight roller bearings. Use of disk wheel makes it possible to locate knuckle spindle substantially in central plane of wheel. Note novel arrangement of thrust bearings in knuckle housing which provides excellent enclosure and a reservoir for oil. Wheel hub is virtually a flush type.

LANCIA (Fig. 2)

A unique Italian design in which the axle center forms a part of the frame while weight of chassis is supported on a helical spring which is concentric with the knuckle pivot. Axle and knuckle support are positioned by struts two of which are attached to the radiator shell which is a part of the combined frame and body structure. Front wheel brakes are fitted.

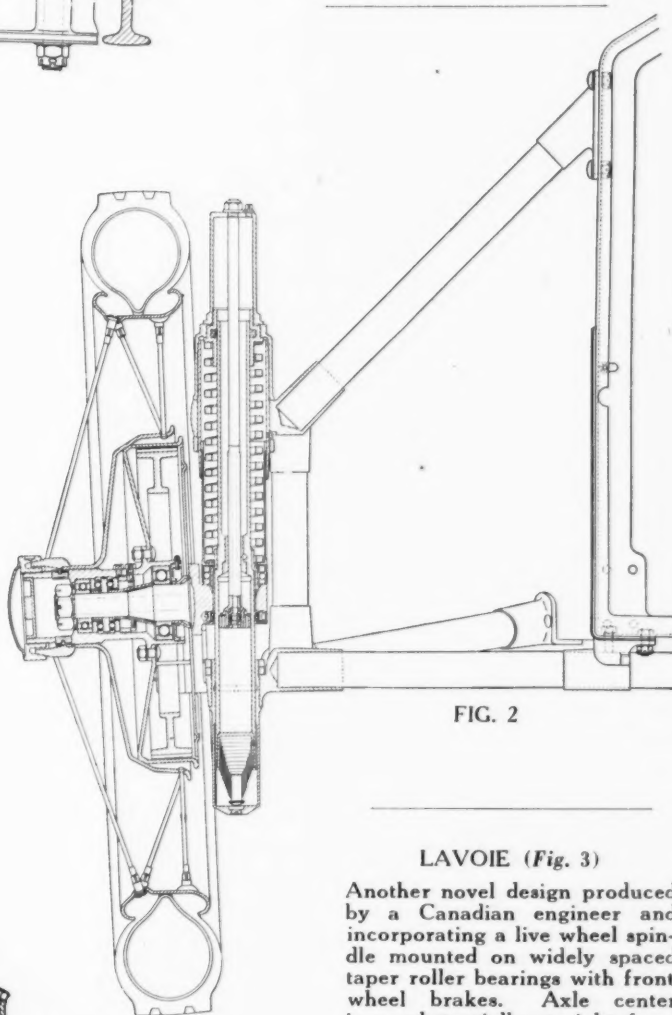


FIG. 2

LAVOIE (Fig. 3)

Another novel design produced by a Canadian engineer and incorporating a live wheel spindle mounted on widely spaced taper roller bearings with front wheel brakes. Axle center is a substantially straight forging with stationary vertical knuckle pivots inserted. Combined knuckle and wheel spindle housing is cast and arranged to fully enclose all bearings and form oil reservoirs. Section of axle center is varied to increase torsional strength near ends and minimize deflection under brake reaction. Knuckle pin has ball thrust and is offset to give cast-ering.

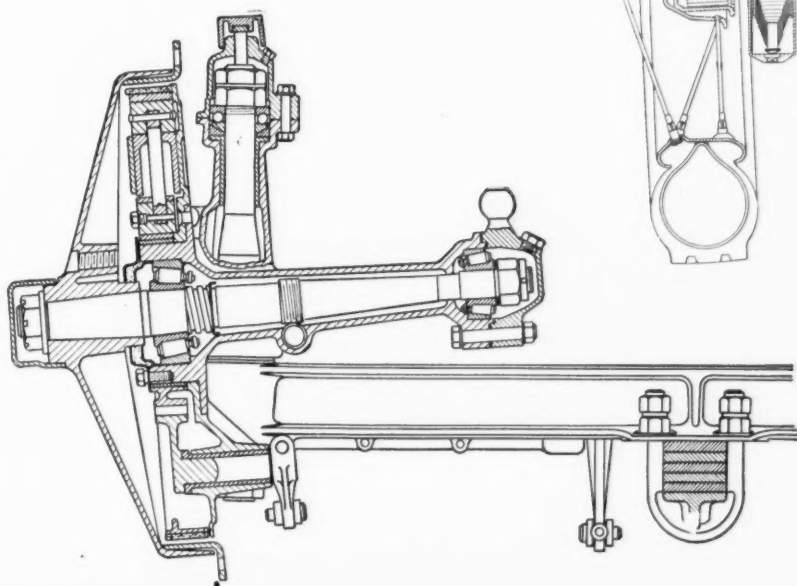


FIG. 3

Recent Clutch Designs

A NUMBER of improvements have been made in clutch design during the past two years. These include:

1. Use of self-aligning parts which tend to compensate automatically for inaccurate machine work and wear.
2. Means for securing more uniform pressure over friction surfaces.
3. Designs intended to secure positive or semi-positive disengagement.
4. Better facilities for lubrication where this is required or elimination of certain wearing surfaces which require lubrication.
5. Easier means for adjustment, some of which are made more or less foolproof.
6. Means for decreasing the pressure required to disengage the clutch.
7. Use of a construction which tends to prevent warping due to overheating.
8. Use of radial type throwout bearings, usually arranged to run only when the clutch is disengaged.
9. Wider use of anti-rattle features.
10. More general adoption of pressed metal parts.

All of these features will be apparent by a careful study of the accompanying drawings showing some good examples of clutch designs which have been placed on the market either by parts makers or by concerns which manufacture complete cars or trucks.

NEARLY all of the changes listed above are calculated either to give improved operation, longer life or less need for attention on the part of the user. There is still room for material improvement in many clutches now being manufactured, but there are indications of a better appreciation of the fundamental requirements of good clutch design than have heretofore been apparent.

Improvements have, in some cases, added to the cost of the finished products. Many of them have been incorporated, however, without increasing cost and some with a decided decrease over earlier forms of construction.

Considering now in more or less detail the developments enumerated in the first paragraph, we find the use of self-aligning designs, especially in the case of clutches built for the parts trade, increasing rapidly. The advantage of this construction lies partly in greater freedom from trouble in service and partly in the fact that less care is required in machining various parts to close limits and in assembling them in the flywheel of the engine. Very often one of the friction surfaces employed is that of the flywheel web itself and, since this part is seldom manufactured by the clutch maker, the chance for misalignment and consequent uneven bearing on the friction surfaces is considerably increased. Even some makers who build both the engine and clutch find self-aligning features desirable, owing to unequal wear which may occur in service or incorrect adjustment by incompetent mechanics.

In general, self-alignment is secured by the use of two surfaces which form a part of a sphere or the equivalent of a ball and socket joint. These parts are usually so arranged that they give an equalized pressure on the multiplying levers or other means for transmitting the pressure from the springs to the pressure plate. Such a construction is especially desirable when a single concentric spring is employed in combination with levers which multiply the pressure on the disks.

THE desirability of a uniform pressure over the friction surfaces is more or less obvious, but has in the past been frequently overlooked. Unequal pressure is apt to cause unequal wear and a tendency to chatter, together with a less gradual engagement than is generally desired. Uniformity of pressure is secured by employing a number of springs equally spaced around the friction surface, or by the use of heavy pressure plates which do not appreciably distort when an unequal pressure is applied. When more than one spring is used it is desirable, of course, to have the springs calibrated so that they all give substantially the same pressure. As many as twenty springs are used in some designs, while in others, where a single spring is employed, a large number of multiplying levers apply the pressure at a number of points on the pressure plate.

In many early single plate clutch designs, no means were provided for positive disengagement, with the result that the clutch continued to drag after the spring pressure was removed in disengagement. This fault is now overcome or minimized by the use of means for positively withdrawing the pressure plate or of secondary springs arranged to move the pressure plate outward away from the friction disks when the main spring thrust is removed by the act of disengaging. This does not necessarily insure immediate disengagement for the reason that the friction surfaces may remain in contact, especially where floating friction disks are employed, but it reduces the tendency to drag.

THERE are two or three bearing surfaces in most clutches which require a limited amount of lubrication, but more or less difficulty is frequently encountered in lubricating these surfaces. It is, therefore, pleasing to note that better means for such lubrication as is necessary are being employed. The amount of lubricant required on the throwout bearing and the sliding sleeve is small but, if either becomes dry, a tendency to stick or become noisy may cause considerable annoyance to the user.

A reservoir containing a considerable volume of oil is successfully used in some designs both for lubrication of throwout bearing and the sliding sleeve. In other cases there is no contact between the throwout sleeve and the clutch shaft, so that no lubrication is required

Many Improvements to Provide Longer Life and Better Operation Are Noticeable in Types Developed Last Year

at this point. This does not, however, render unnecessary a convenient means for lubricating the throwout bearing.

ONE of the most difficult bearings in the clutch assembly to lubricate is the pilot bearing. This is usually a ball type which requires but little oil, yet that little is quite necessary for long life. Unfortunately, however, the bearing is difficult to reach and is therefore neglected. In some cases the crankshaft is drilled and provided with a felt plug which permits a slight seepage of oil to the pilot bearing, but it is difficult to control the amount of oil fed and avoid over or under oiling. In some designs the ordinary pilot bearing has been eliminated, especially where a unit powerplant is not employed, and the clutch shaft is guided in a long sleeve held in position by the cover plate which serves to enclose the clutch. Such a bearing is relatively accessible and can be used with success only when adequate provision for its lubrication is provided.

Where the expense of an annular throwout bearing is warranted, this type can often be employed to advantage and is generally considered a necessity if a construction is such that the bearing runs continuously when the engine is running. A construction in which the bearing turns only when the clutch is disengaged is apt to have a longer life and is less likely to become noisy.

Ease of adjustment is a particularly desirable feature in any mechanism which is certain to require such adjustment periodically. Most present day clutch designs incorporate some convenient means for adjustment, especially when levers are used to multiply the spring pressure. In some cases such adjustments are rendered practically foolproof, a feature which is especially desirable when the design is not such as to automatically compensate for any unequal adjustment which may be made by an incompetent mechanic.

There appears to be a general tendency toward the use of clutch designs in which the pedal pressure required for disengagement is much less than was formerly employed. This has been accomplished, as a rule, by the use of multiplying levers usually incorporated within the clutch itself rather than in some external mechanism between the pedal and the throwout yoke.

A FAULT sometimes encountered in clutches of the disk type is the tendency of the disk or disks employed to distort due to overheating. This tendency is overcome in many recent designs by the use of radially slotted plates so arranged that expansion can occur without warping. The desirability of this form of construction is evident, even though it may in some cases slightly increase first cost.

Among the disadvantages sometimes cited against plate and disk clutches is a tendency to rattle upon disengagement. Means used to avoid this fault include increased area of bearing surfaces between driving and driven elements, with consequent decrease in wear and back-

lash. Springs, so arranged as to prevent rattle by keeping parts which tend to rattle under pressure at all times, are also used to advantage in some designs.

The increased use of pressed metal parts is at once evident from a study of the accompanying clutch designs. This tendency is commendable in cases where cost is reduced without detriment to wearing qualities or sacrifice of good operation. In some cases, however, the use of rather heavy cast pressure plates has proved a decided advantage on account of the greater uniformity in pressure and a less tendency to chatter and warp. It is probable that a heavy pressure plate also helps to dissipate heat or to temporarily absorb heat which might otherwise cause warping if light pressed metal parts were employed.

On the other hand, where a certain degree of flexibility is desirable, pressed metal has obvious advantages and is frequently used, especially for light driven members, some of which are made only 1/16 in. thick.

THERE are some advantages in the use of a fully enclosed clutch, but with this type of construction any circulation of cool air from outside the flywheel tending to carry off heat caused by slipping the clutch is precluded. In some cases an open construction tending to facilitate air cooling is employed to advantage.

The use of clutch brakes appears to be decreasing due, perhaps, to the general use of lighter driven members and to a better appreciation of the fact that while such a brake is sometimes an advantage in changing from a lower to a higher gear, it is a corresponding disadvantage in changing from a higher to a lower gear.

More care than was at one time given to the matter of balance is now exercised in clutch manufacture, but there is still room for improvement in this respect in some cases. An "inherently" balanced design is desirable, but perfect balance is obtained with certainty only by carefully testing each clutch. The design should, of course, not be such that necessary adjustment may throw it out of balance.

Among the factors which have not been given sufficient consideration in some designs may be mentioned the use of a construction which is difficult to dismantle and reassemble in the service station when new linings are required and the use, in some cases, of driven members which appear to be unnecessarily heavy. Other things being equal, it is desirable, when floating friction disks are not employed, to rivet these disks to the driving rather than to the driven members, otherwise the moment of inertia of the driven member is very materially increased with the result that this member continues to spin after disengagement and gear changing is correspondingly more difficult.

A FEATURE of some designs which is appreciated by those who assemble cars from component parts is the use of a self-contained construction, or one in which the entire clutch forms a unit which is installed without the need for assembling it piece by piece in the flywheel.

RECENT DEVELOPMENTS IN CLUTCH DESIGN

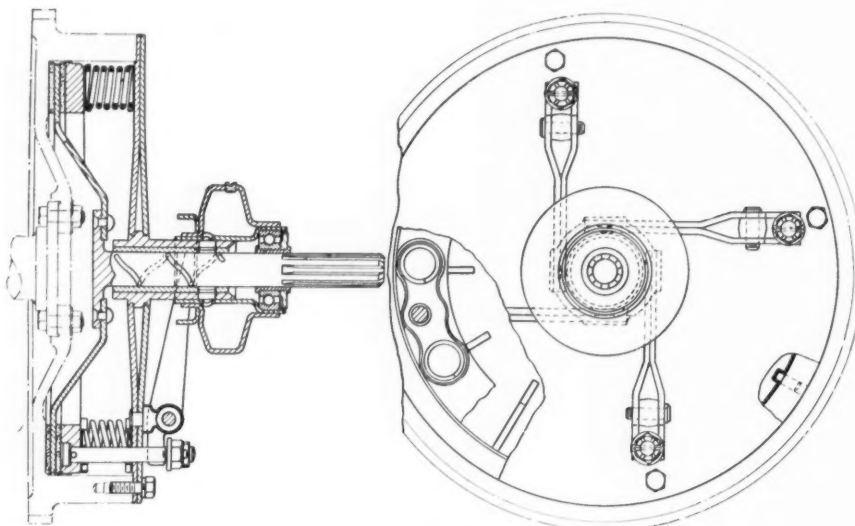


FIG. 1

DURANT (Fig. 1)

A design employing chiefly pressed steel parts and arranged for use with separate gear-set. No pilot bearing is used in flywheel. Note large reservoir for oil for sleeve and throwout bearings. Positive withdrawal of pressure plate is accomplished through multiplying throwout levers. Driven plate is slotted radially.

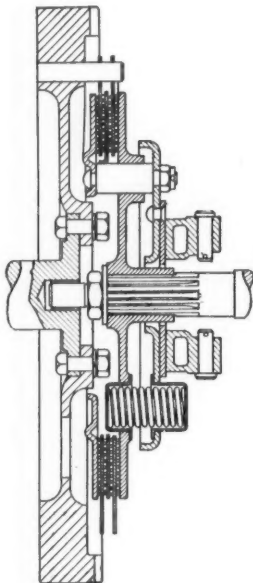


FIG. 2

CHEVROLET COPPER-COOLED (Fig. 2)

Two driving plates are carried on three pins in flywheel and are faced with asbestos cord fabric. Driven members include front and rear pressure plates, intermediate plate, six springs and spring carrier. Splined malleable iron hub carries three driving and three alignment pins. Throwout is a bronze casting with cored oil pocket. Six springs fit into metal cups. No means for adjustment is provided.

GRAY (Fig. 3)

A single-plate type designed to run in oil. Facings are of compressed cotton, are riveted to driven member, and designed to operate under a unit pressure of 28 lb. per sq. in. Six springs act directly on heavy pressure plate which is positively withdrawn on disengagement. A bronze throwout bearing is used and no adjustment is provided.

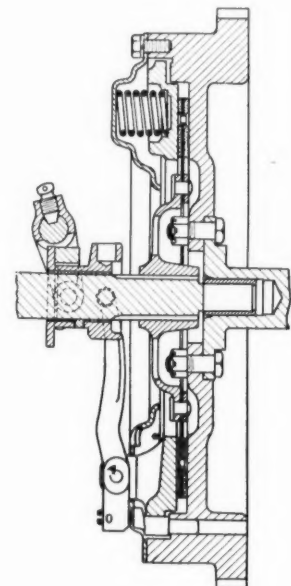


FIG. 3

STAR (Fig. 4)

A design which resembles the Durant clutch in most essential features but uses fewer parts. Three throwout levers are employed to positively withdraw heavy pressure plate. A large oil reservoir is fitted around throwout sleeve which serves also as the pilot bearing. Most of the parts are formed from pressed steel. Six direct acting springs are arranged in pairs each side of adjustable throwout bolts.

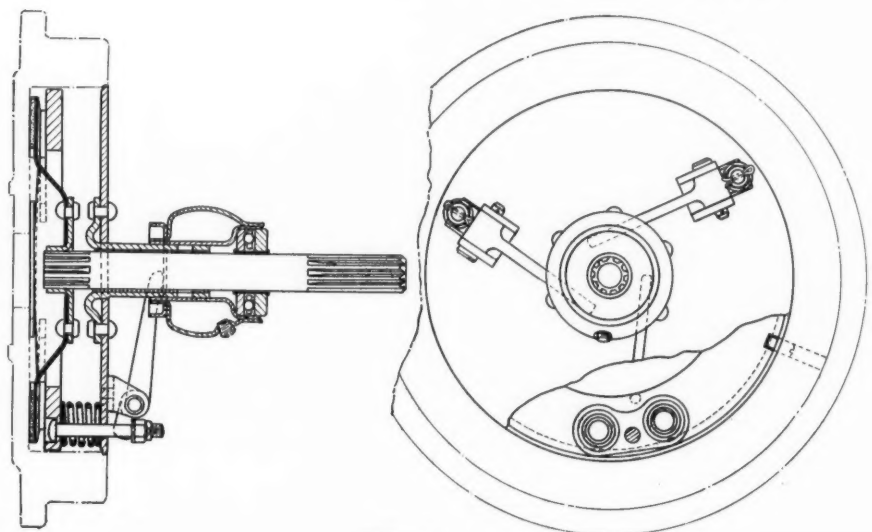


FIG. 4

RECENT DEVELOPMENTS IN CLUTCH DESIGN

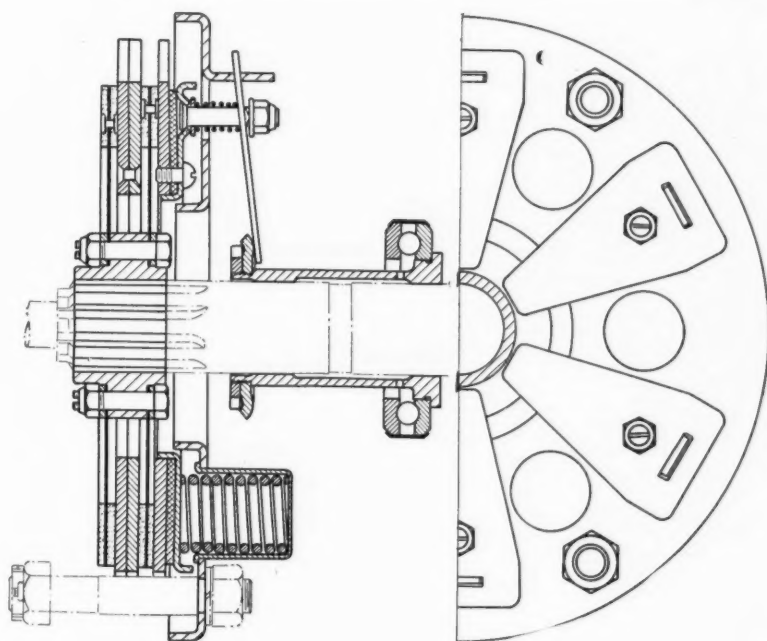


FIG. 5

LONG (Fig. 5)

A new design incorporating two driven plates to both sides of which are attached facings. These plates are bolted to the hub. There are six direct acting springs each of which exerts a pressure of 100 lb. The six pressed steel disengaging levers with fulcrums at their outer ends are held in place by the springs thus preventing rattle.

BAKER (Fig. 6)

Pressure plate has spherical surface intended to compensate for misalignment and give uniform pressure over entire bearing surface of floating friction disks. Single volute spring acts through levers with fulcrums on adjusting screws in cover plate. Extra disengaging springs are used to withdraw pressure plate on disengagement. Throwout sleeve has no bearing on clutch shaft, so only one ball bearing is required. Note extensive use of pressed steel parts and arrangement of throwout levers inside cover plate.

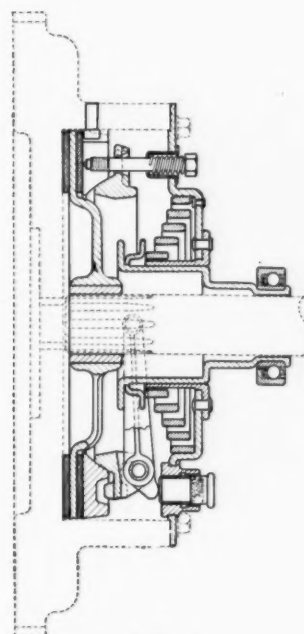


FIG. 6

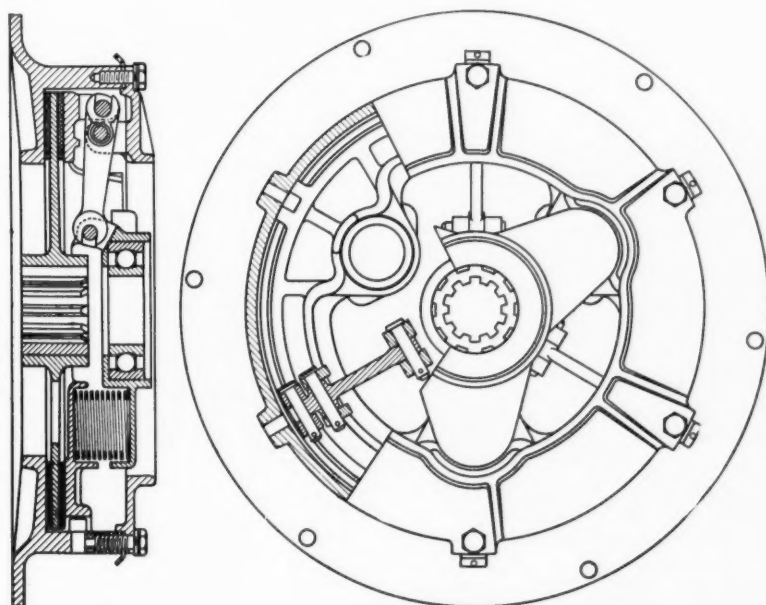


FIG. 7

RICKENBACKER (Fig. 7)

An unusual design in which the springs act directly upon the pressure plate as well as through the multiplying throwout levers. Pressure plate is positively withdrawn on disengagement. Adjustment is effected by removing six 1/16 in. shims. The three 110 lb. springs are designed to exert a total pressure of 1650 lb. on the floating friction disks.

RECENT DEVELOPMENTS IN CLUTCH DESIGN

MERCHANT & EVANS

(Fig. 8)

Made with one or two flexible driven disks riveted to splined steel hub. Heavy pressure plate is positively withdrawn on disengagement through levers the outer ends of which bear on a stepped ring which forms fulcrum and serves also as means for adjustment. Release sleeve is entirely clear of shaft so that throwout bearing is only one required. There are six direct acting springs giving total of 1200 lb. pressure.

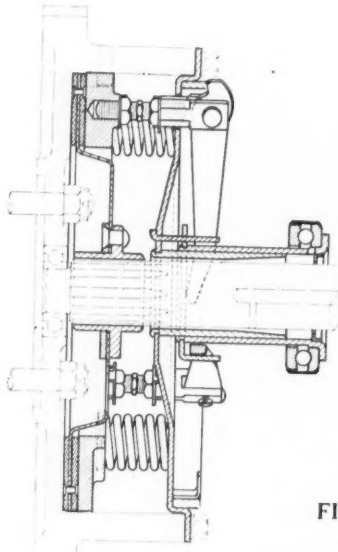


FIG. 8

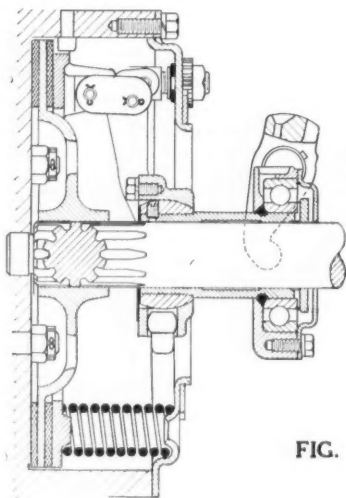
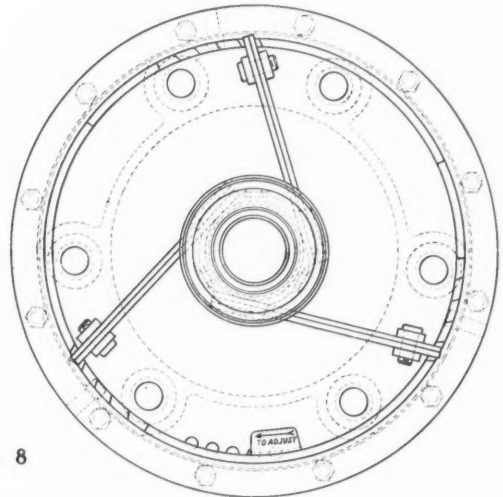
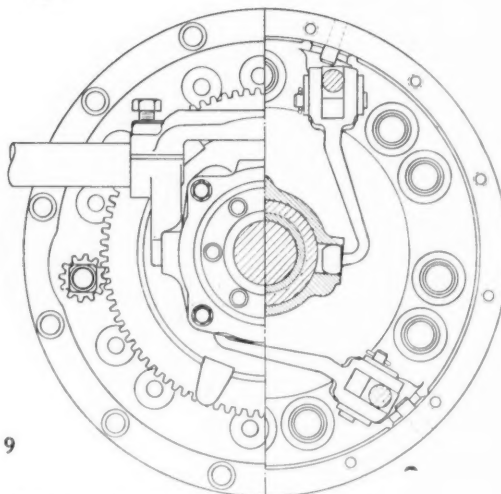


FIG. 9



DETROIT GEAR and MACHINE

(Fig. 9)

A design incorporating a self-aligning hub which prevents binding. The twelve direct acting springs give uniform pressure on heavy pressure plate which is positively withdrawn on disengagement. Toggle levers, held firmly to prevent rattle, are used to decrease required pedal pressure. Adjusting nuts which control position of toggle fulcrums mesh with stamped gear ring.

BROWN-LIPE

(Fig. 10)

Driven member is a steel forging with four steel sector plates riveted to it. Space between sectors is allowed for expansion due to heating. Hub splines are hardened. Pressure plate has heavy stiffening rib against which twenty throwout levers are arranged to uniformly distribute pressure of single volute spring. Release sleeve is free of shaft.

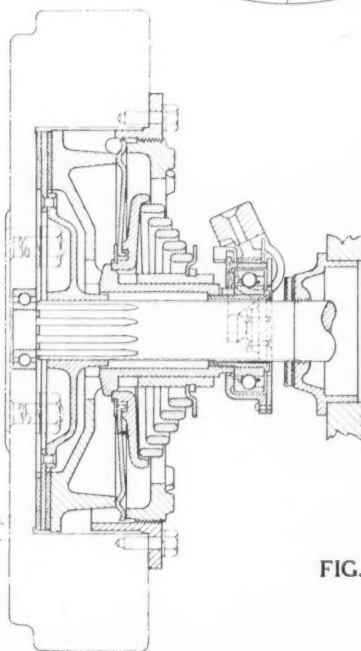
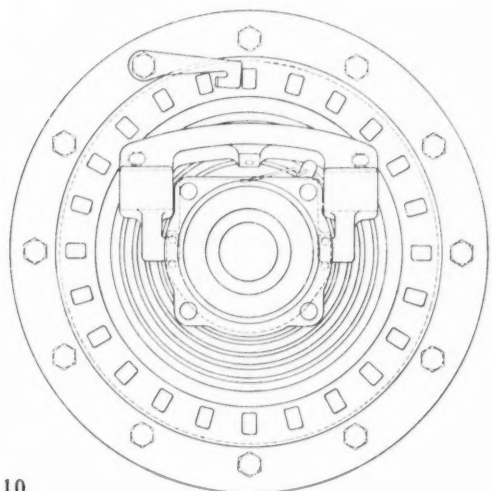


FIG. 10



RECENT DEVELOPMENTS IN CLUTCH DESIGN

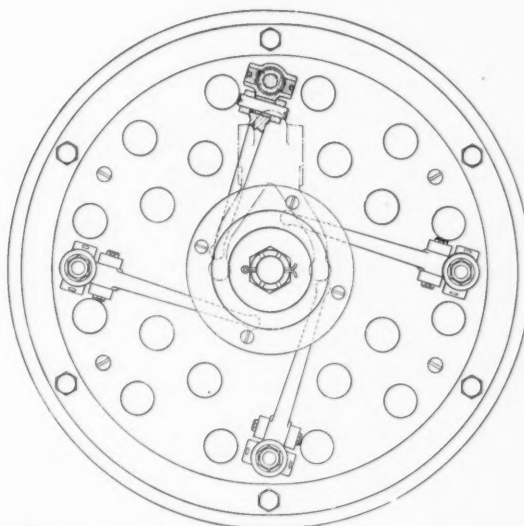
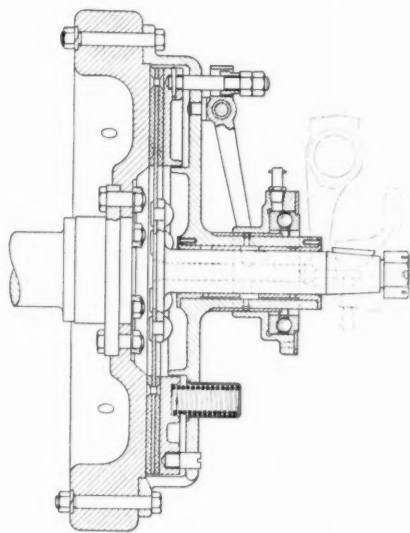


FIG. 11

FIFTH AVE.
COACH CO.
(Fig. 11)

In this design twenty direct acting springs are employed to give uniform pressure on the friction disks which are riveted to the driven member. Multiplying throw-out levers are balanced. Easy adjustment is a feature.

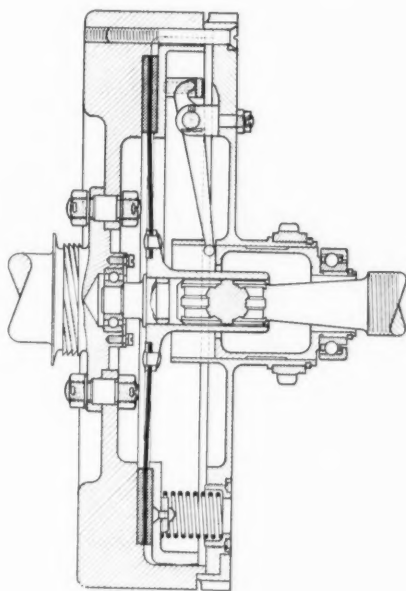


FIG. 12

RUBAY (Fig. 12)

Driven plate is of 1/16 in. saw steel which is dished 1/64 in. to assist in positive disengagement and easy engagement. There are twelve direct acting springs which press against the L section pressure plate which is positively withdrawn by three disengaging levers located inside the cover plate.

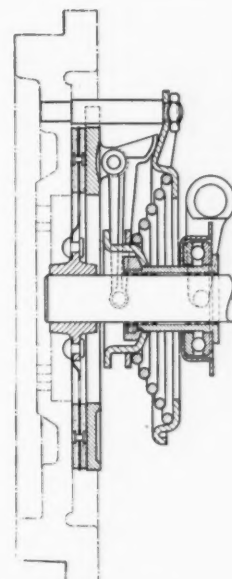


FIG. 13

HOOSIER
(Fig. 13)

A compact design in which toggles are used to multiply pressure of single volute spring. No adjustment is said to be required during life of friction matts which are riveted to light driven plate. No clutch brake is required.

AMERICAN-
LaFRANCE (Fig. 14)

A multiple-disk truck clutch embodying a self aligning pressure element between toggles and adjusting ring. Auxiliary springs are arranged to withdraw pressure plate on disengagement. A single spring acts through toggle levers which give light throwout pressure.

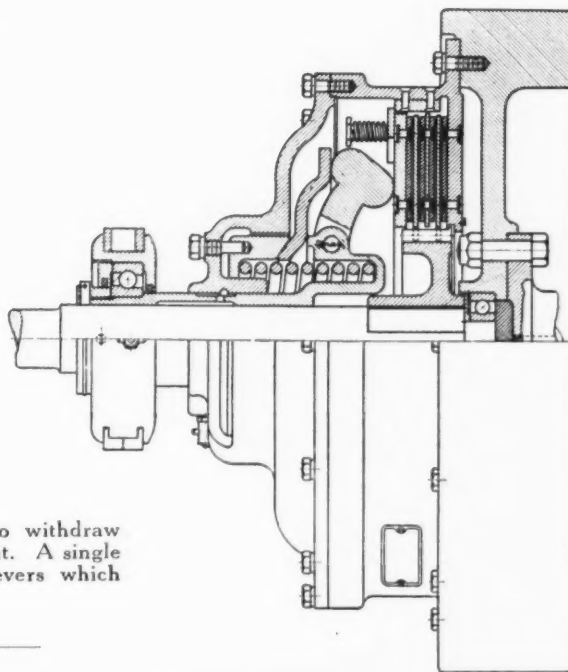


FIG. 14

A FEW INTERESTING TIRE CARRIERS

FOX (Fig. 1)

Three tubular arms are cast radially in a center mounting bracket. Fixed saddles are riveted in outer ends of two upper arms and a screw operated saddle telescopes in the lower. Screw extends upward through center bracket and ends in a two-armed hand lever. A lug riveted in lower arm prevents rotation of lower saddle. After spare rim is hung over upper saddles rotation of hand lever secures it.

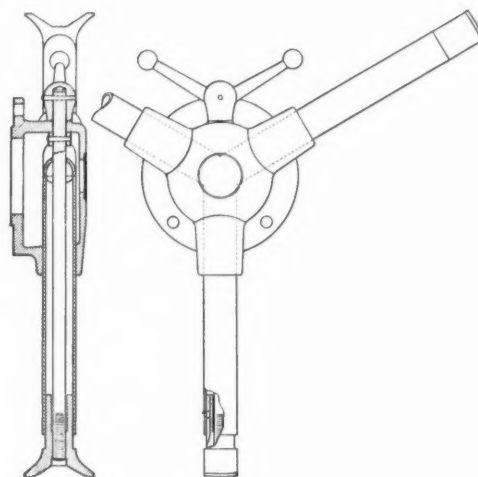


FIG. 1

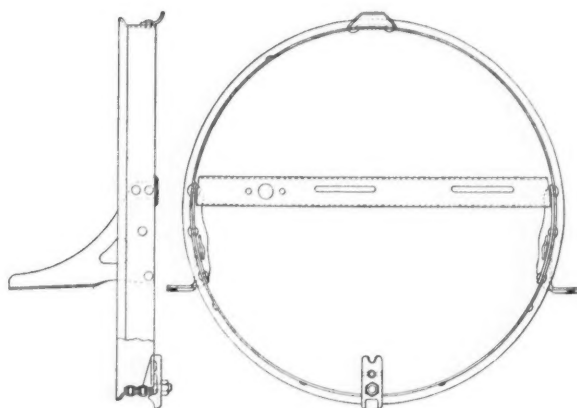


FIG. 2

DORT (Fig. 2)

A standard felloe band, reinforced by a pressed steel cross member, is supported at the rear end of frame by two riveted in brackets of pressed steel. The spare rim is hooked over the riveted strip at top of band and retained by a lug and nut at bottom.

GARDNER (Fig. 3)

Two pressed steel brackets which also carry the gasoline tank support a standard felloe rim from the rear end of the frame. The spare rim is held by the locating lug at the top and by a single standard clamp at the bottom. As the pressed steel brackets are of liberal section and a reinforcing bar which carries the tail lamp and license plate extends across the rim, the entire assembly combines rigidity and light weight.

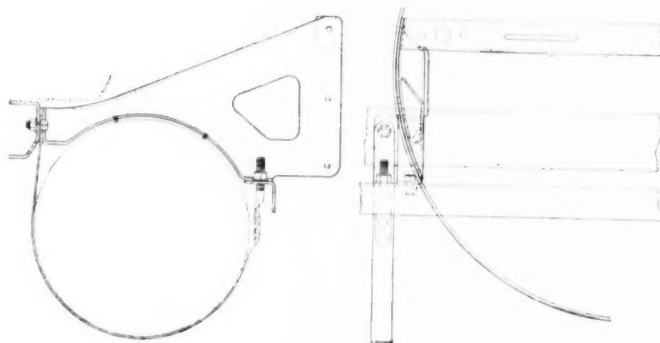


FIG. 3

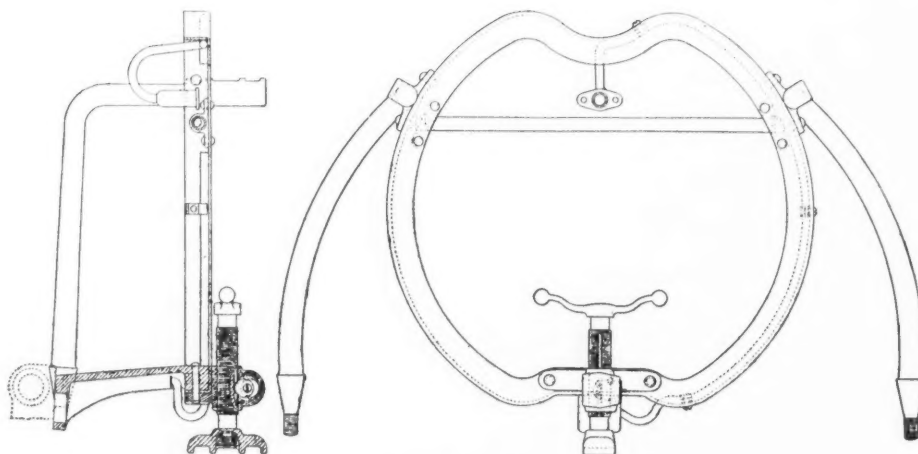


FIG. 4

LAFAYETTE

(Fig. 4)

A heavy rolled steel frame which is reinforced by a tubular cross member is supported by two forged and one cast bracket. The depression at the top accommodates the tire valve. The spare rim is clamped by the hand screw at the bottom and secured by a cylinder lock.

A FEW INTERESTING TIRE CARRIERS

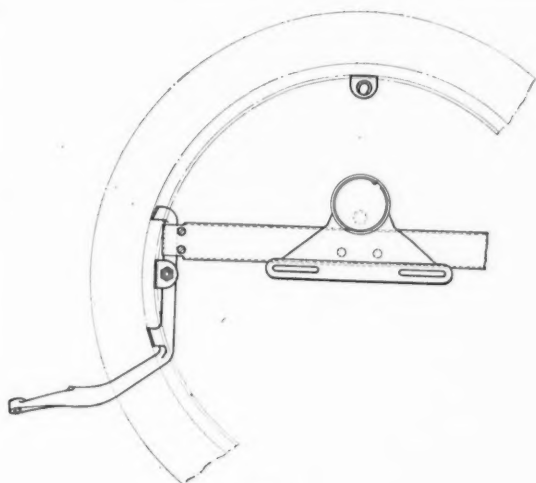


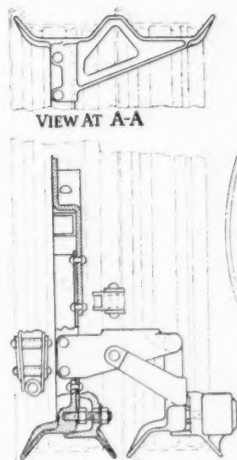
FIG. 5

STAR (Fig. 5)

Two locating surfaces and stops are forged on outer ends of two forged brackets, each bolted to rear end of frame at opposite sides. Standard clamps are drawn against spare rim by bolts threaded into each of the brackets. A channel section rolled steel cross member is riveted between brackets, tying assembly together.

STANLEY (Fig. 6)

Carrier is fitted with double saddles. The second half saddle and wedge clamp are carried by a hinged extension from a horizontal arm riveted to lower arm of single carrier. Cylinder lock button is fitted to only the outer carrier but locking both spare rims.



VIEW AT A-A

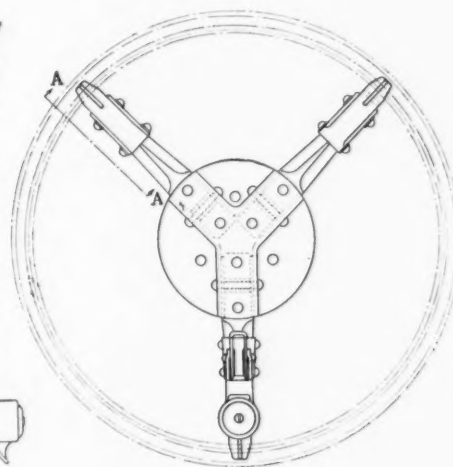
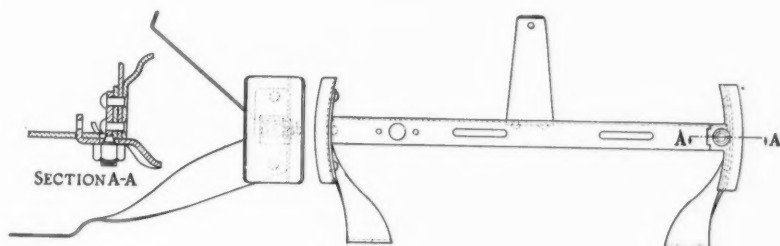


FIG. 6



SECTION A-A

FIG. 7

GRAY (Fig. 7)

A pressed steel assembly, which is bolted to rear end of frame and braced by a strap extending to back of body. The cross member between the plain pad and clamping pad carries the license plate and tail lamp. The spare rim is first placed over the plain pad and then swung over the clamping pad. Clamp is then drawn up by a nut. A lug on the clamp extends through the cross member, permitting use of a padlock.

DURANT (Fig. 8)

Fixed and removable cast clamp members are fitted over threaded and reduced bracket ends. Clamp members hold rim at three points. Inner or fixed clamp members on two upper brackets are connected by a steel cross piece. Lower bracket is riveted to rear cross member. Upper brackets are carried in taper sockets at rear ends of side members.

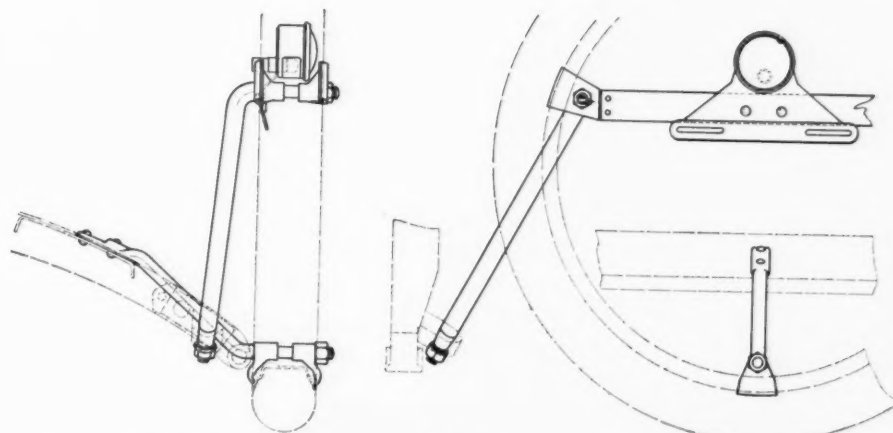


FIG. 8

A FEW INTERESTING TIRE CARRIERS

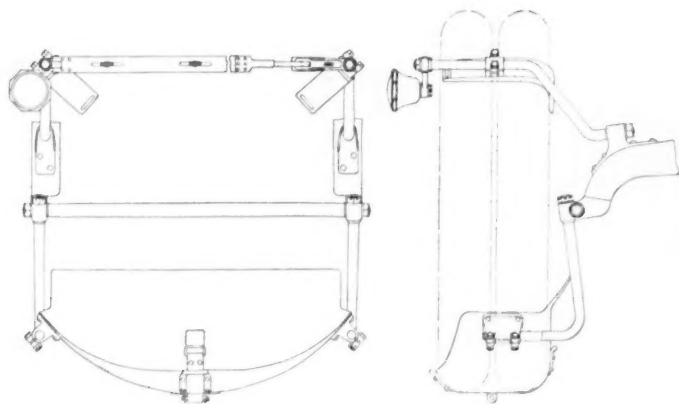


FIG. 9

LOCOMOBILE (Fig. 9)

The lower carrying pan and the two upper retaining pads are clamped on forged steel brackets which extend from the rear end of the frame. Straps are drawn around the tires at three places and a hinged locking bar which also carries the license plate swings between the two upper supports, being secured by a padlock. Wire wheels, spare rims and, with slight modifications of the straps, disk wheels can be accommodated in this carrier. The general arrangement was adopted to facilitate the handling of the heavy tires which are used on this car.

FLINT (Fig. 10)

Thin section pressed steel members which are riveted together to form an inverted semi-circular spare rim saddle reinforced by a wide channel section containing the tail lamp and license plate mounting are supported by forged brackets from each side of the rear end of the frame. Retaining clamps are drawn up against the spare rim by nuts threaded on extensions riveted midway between the ends of the saddle and locating bosses which are forged on each of the supporting brackets.

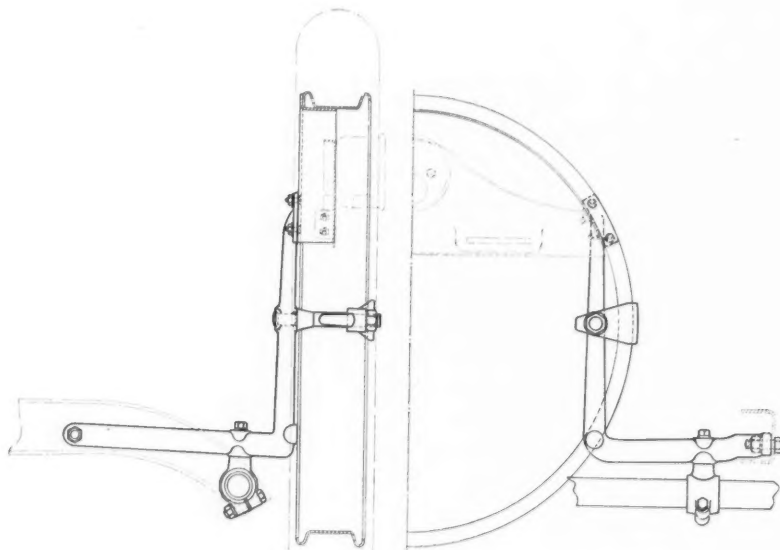


FIG. 10

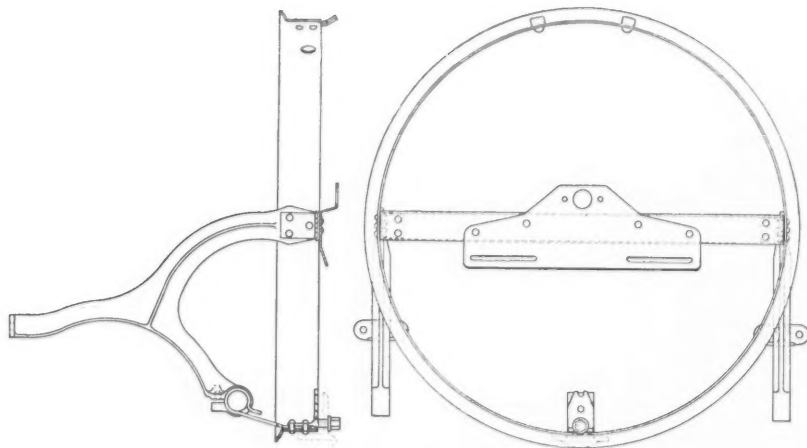


FIG. 11

HUPMOBILE (Fig. 11)

A rolled steel felloe band is riveted to the outer ends of two malleable iron brackets which are supported at the rear cross channel, and a cross tube, forming the saddle for the gasoline tank. Two hooks at the top and a clamping wedge lug at the bottom retain the spare rim. The lower lug may be secured by a padlock. The pressed channel cross member carries the license plate and tail lamp.

A FEW INTERESTING TIRE CARRIERS

BARLEY (Fig. 12)

Three radial U-section pressed steel arms are riveted at their inner ends, in a heavier pressed steel circular mounting flange which in turn may be attached to the rear or side of the chassis as desired. Malleable cast saddles are riveted in the outer ends of the upper arms and a wedge clamp is drawn against a cast half saddle which is riveted into the lower arm. The wedge clamp may be fitted with a cylinder lock plug which covers the clamping nut. This carrier is made by the Oakes Company.

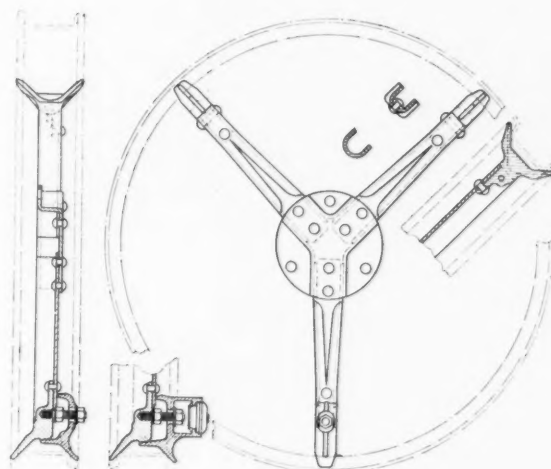


FIG. 12

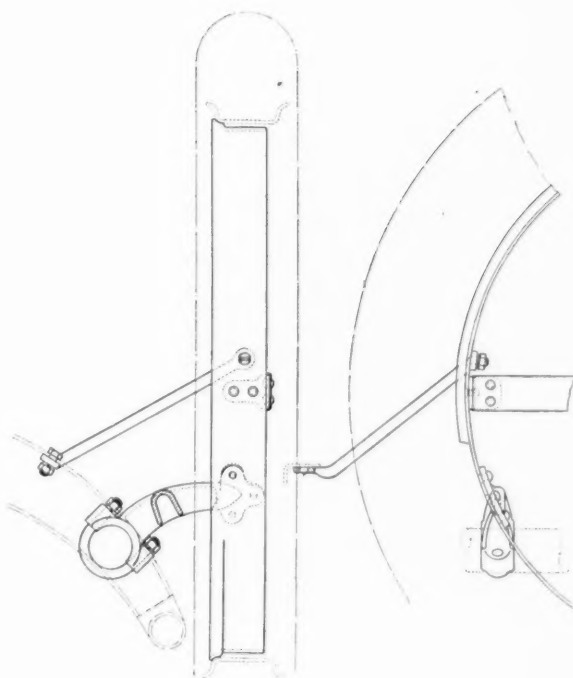


FIG. 13

STEPHENS (Fig. 13)

Malleable iron brackets and forged steel braces support a felloe band from the rear end of the frame. A pressed steel reinforcing member is riveted in at the horizontal diameter of the band. The spare rim is secured by a standard detachable lug and a nut.

MARMON (Fig. 14)

Two fixed lugs and a telescopic plug which are mounted on a pressed steel spider, fit into a groove inside of the spare rim and form a three-point expanding chuck. The center flange of the spider is bolted to the rear cross channel and a steel brace supports the spider at the end of the lower radial arm. The telescopic plug is operated by a short lever having provisions for a padlock at the closed position.

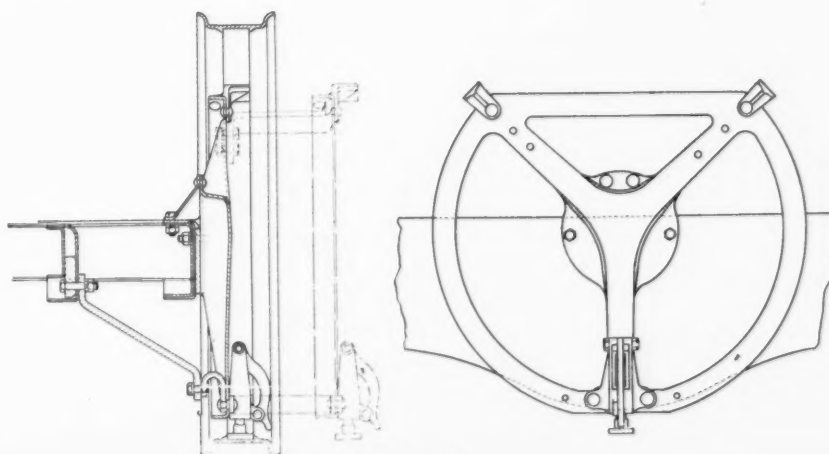


FIG. 14

SPRING SHACKLE IMPROVEMENTS and SUBSTITUTES

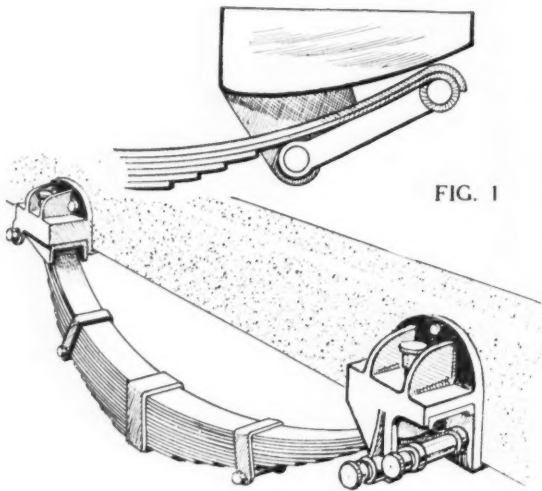


FIG. 1

Fig. 1—Spring attachment used by BRISTOL TRAMWAYS CO. Shackle sets at an angle and serves chiefly to position the spring. Under load the spring bears on the under surface of case hardened curved slippers so arranged that spring becomes stiffer as load increases.

Fig. 2—Rear spring on German N. A. G. bus chassis. No shackles are employed. Ends of spring are bent downward and rest on frame brackets so arranged that effective length of spring decreases from 56 to 43 in. from light to full load, thus making for easier riding.

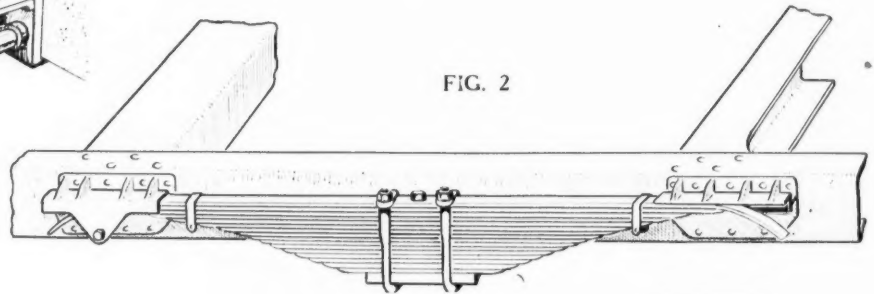


FIG. 2

Fig. 3—RUBAY, front end of rear spring slides between well inclosed hardened rollers.

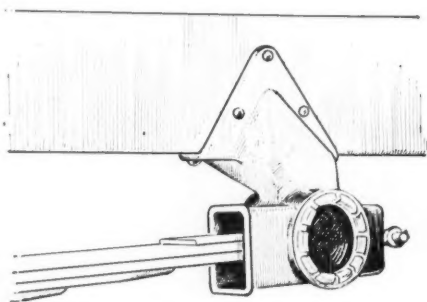


FIG. 3

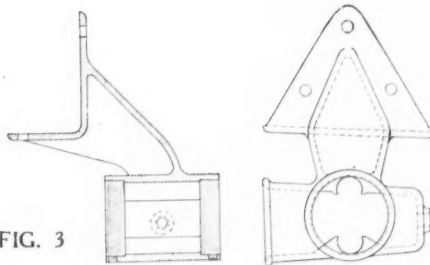


Fig. 6—A. C. SCHULZ shackle. Bolt is clamped in one side and adjustable thrust bushing in other.

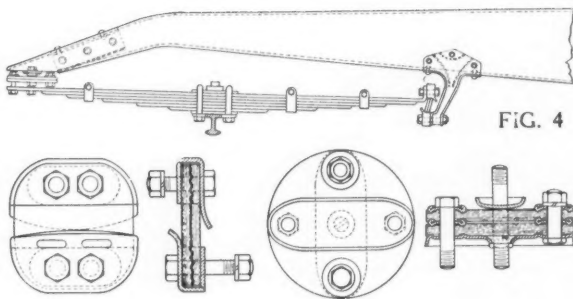


FIG. 4

Fig. 4—BEL-FLEX rubberized fabric shackles which eliminate metal to metal contact between spring and frame.

Fig. 5—Latest design of rubber shock insulators used in place of shackles on MACK bus chassis. No metallic contact between spring and bracket.

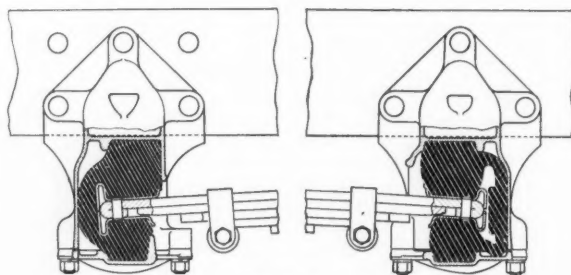


FIG. 5

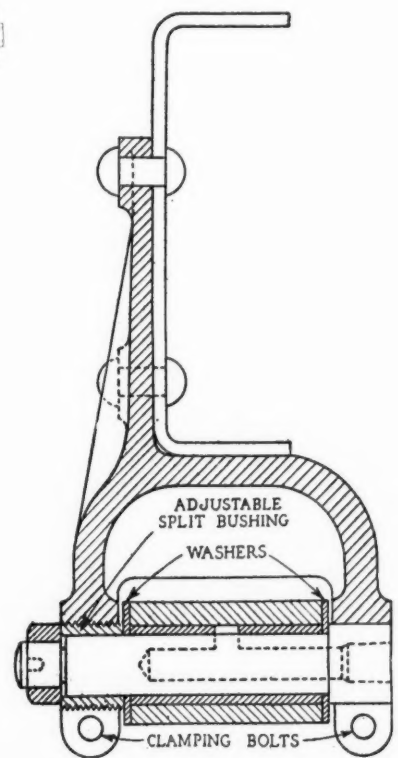


FIG. 6

SPRING SHACKLE IMPROVEMENTS and SUBSTITUTES

Fig. 8—Spring and mounting designed by W. D. KELLY. Leaves are wide in center and taper to narrow section at each end. Spring eyes and bolts are replaced by enclosed journal segments with large bearing surfaces and provision for adequate lubrication.

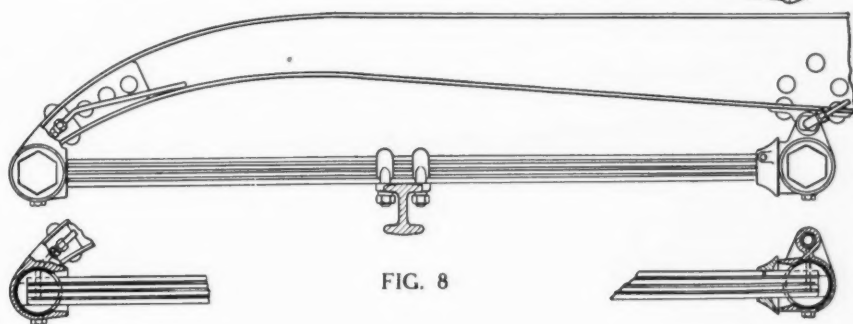


FIG. 8

Fig. 7—Rear spring mounting on GALLO-WAY, a light British car. Main leaf of spring rests between two hardened steel rollers one of which is threaded over the transverse bolt. A gaiter is used to complete enclosure and exclude dirt.

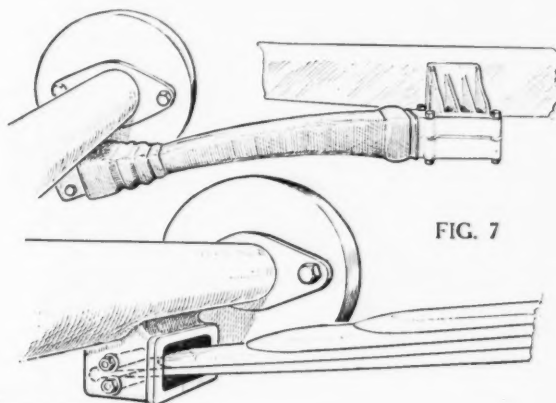


FIG. 7

Fig. 9—Details of roller brackets used in place of spring shackles on the German PRIAMUS chassis. The main leaf of the spring bears against a roller bearing which is grease lubricated. Fibre blocks are arranged to take side thrust.

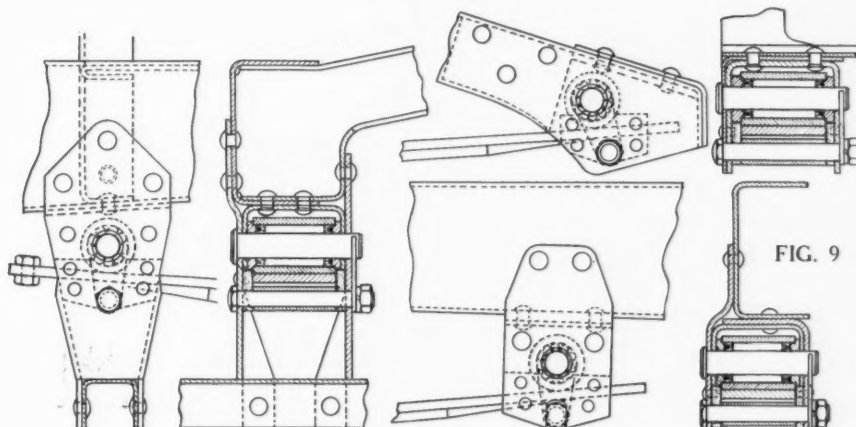
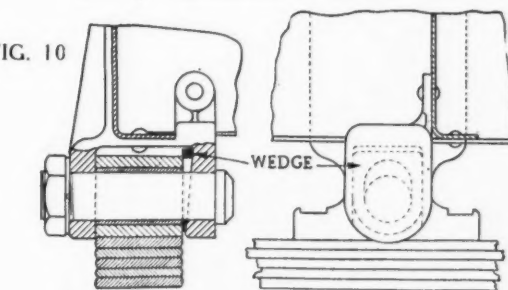


FIG. 9

Fig. 10—Shackle, designed by H. C. GIBSON, in which a wedge is employed to take up wear caused by side thrust on the end faces of the shackle. In one application of this principle, the purpose of which is to prevent rattle, the wedge is held in place by springs arranged to push it downward as wear takes place.

FIG. 10



WEDGE

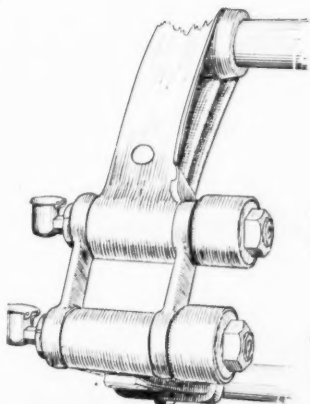


FIG. 11

Fig. 11—Self-adjusting, non-rattle type of spring shackle used on the latest design of CHANDLER chassis.

Fig. 12—McCANDLESS "silent" spring shackle. All motion at enclosed lubricated bearings.

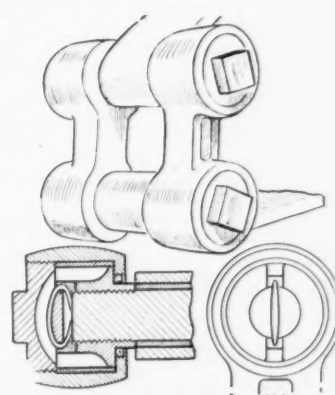


FIG. 12

RECENT STEERING GEAR DESIGNS

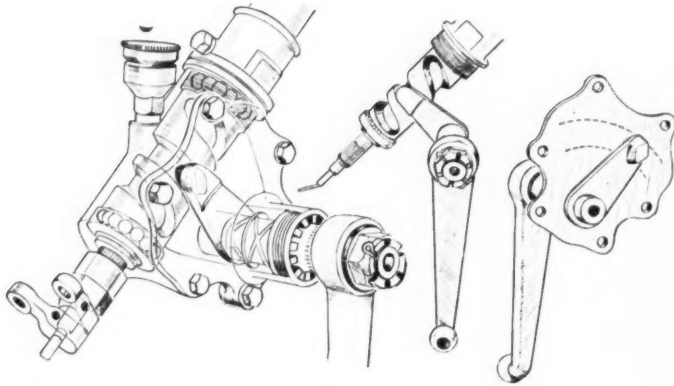
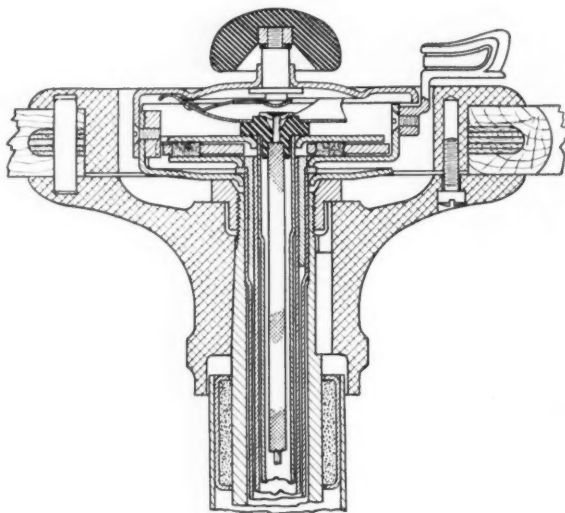


FIG. 1

ROSS (Fig. 1)

A cam and lever type, a modification of the screw and nut type, in which a variable pitch thread, which becomes steeper near the end of the cam travel, is employed.



GRAY (Fig. 2)

Adaptation of the worm and worm wheel type for use in a light car selling in the low price class. In this case plain bearings are employed for both radial and thrust loads. This gear is designed to give a $6\frac{3}{8}$ to 1 reduction, and is employed with a transverse drag-link one end of which is attached to the tie rod.

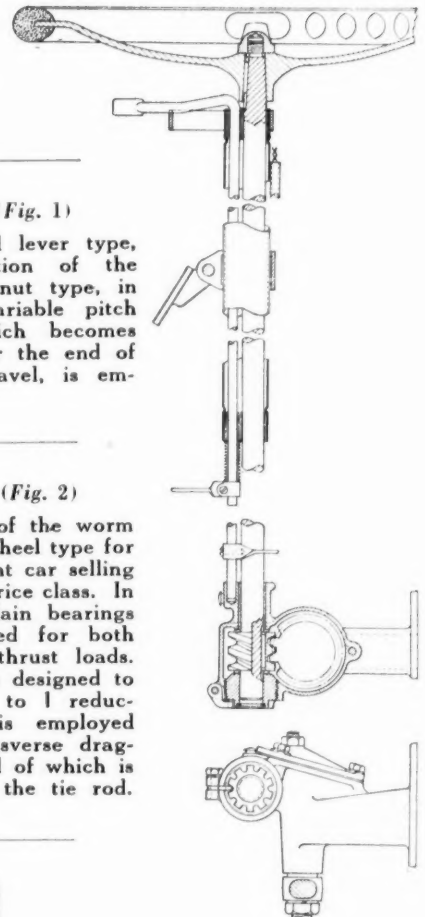


FIG. 2

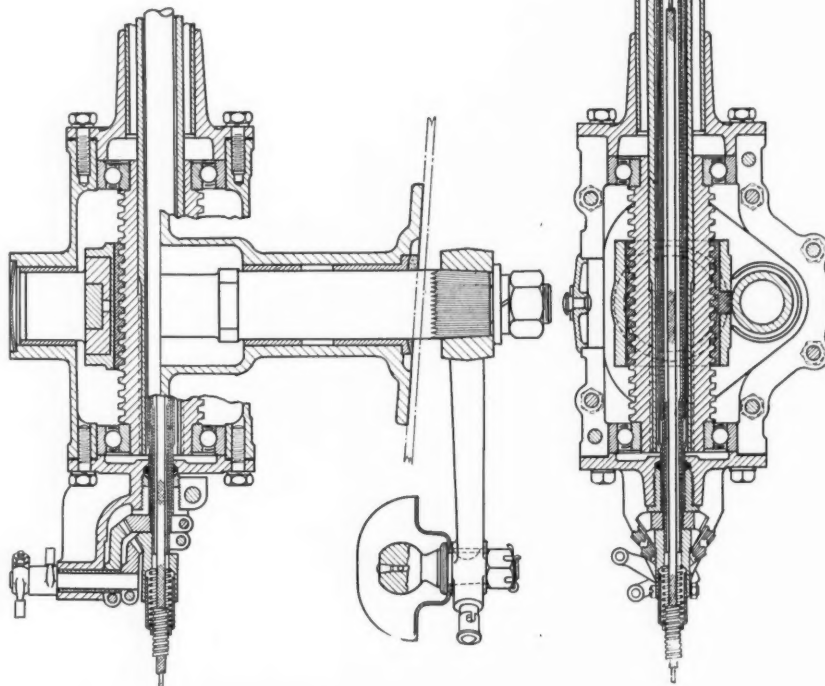


FIG. 3

PACKARD (Fig. 3)

A recent design employed on the new eight-in-line chassis. In order to insure a full bearing on the thread surface the nut is provided with a babbitt lining which is cast around the screw. The latter is mounted in annular ball bearings which take both thrust and radial load, while plain bearings are used on the rocker shaft.

RECENT STEERING GEAR DESIGNS

LAVOIE (Fig. 4)

A Canadian design in which two bronze nuts are used on a divided screw. One nut takes thrust in one direction and the second that in the other direction. The nuts have external splines which fit into slots broached in the housing. The cylindrical end surfaces of the nuts fit segment blocks which bear against a flat crank surface. Wear is taken up by simply turning the threaded plug which closes upper end of housing. This gear is especially easy to assemble and dismantle.

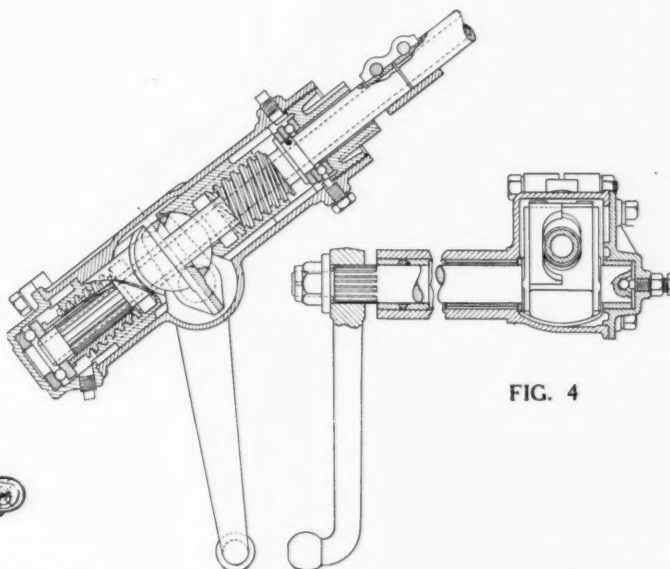


FIG. 4

STAR (Fig. 5)

Another example of worm and worm wheel for light car application. Ball thrust bearings are employed in this case.

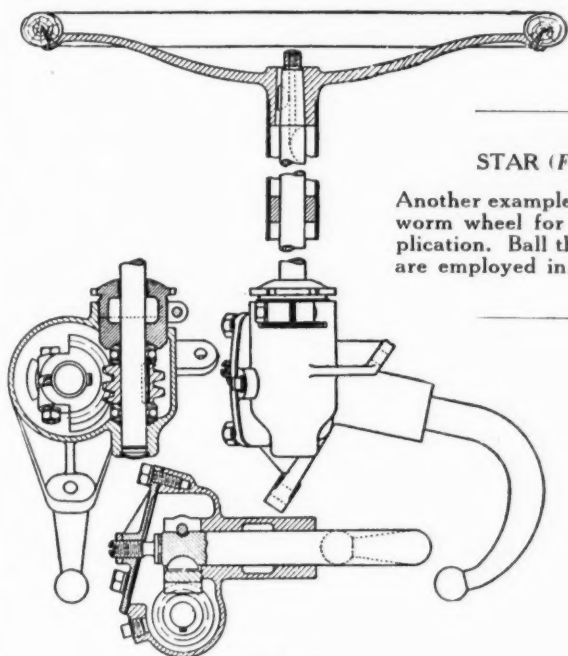


FIG. 5

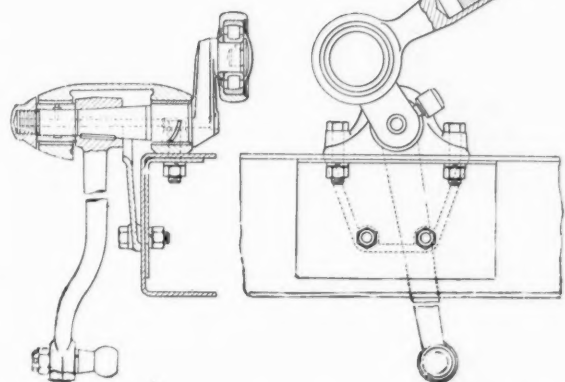


FIG. 6

PRIAMUS (Fig. 6)

A German design in which the crank is mounted on the chassis frame while the worm and nut is in a separate housing which forms a part of the steering column and is attached to the dash. The crank is attached to a crosshead by a connecting rod which is adjustable for length. The steering column is mounted on a pivot which permits it to be adjusted to any desired angle. The crosshead is attached to the nut and arranged to move axially with it. A piston ring carried by the crosshead excludes dirt and retains lubricant. The connecting rod is fitted with a straight roller bearing at its lower end and is attached to the crosshead by a ball enclosed in a socket.

Combustion Chamber Design

DURING the past few years, considerable study has been given to the subject of combustion chamber design, especially with a view to avoiding troubles from detonation and increasing maximum output from a cylinder of given capacity.

Special attention has been paid to means for avoiding so-called hot spots or points in the combustion chamber which reach a temperature so high as to render detonation and consequent pre-ignition difficulties greater. To this end, care has been used to jacket all portions of the combustion chamber walls which have a tendency to easily overheat, or which can, by being kept relatively cool, prevent overheating of other parts, such as exhaust valves, spark plug electrodes and piston heads.

Piston heads have been increased in thickness or the head provided with liberal webs which facilitate the flow of heat from the center of the head to the rings and cylinder walls.

Another tendency, which is seen in many quite recent designs, is the use of a construction intended to bring about a high degree of turbulence in the charge at the time of ignition.

ACCORDING to Ricardo, the value of turbulence lies chiefly in two things which result from its use: first, speeding up of the combustion process by mechanical distribution of the flame following ignition; and, second, the scouring effect which results in washing away from the cylinder walls a film of combustible mixture which may not otherwise be burned on account of the fact that its temperature is never raised sufficiently high to bring about combustion.

Another possible advantage which may be obtained as a result of a high degree of turbulence, especially where relatively non-volatile fuel is employed, is the atomizing and vaporizing effect which turbulence may have when fuel in a liquid state enters the cylinder and is deposited on relatively cool surfaces.

Whatever may be the practical result of turbulence, a number of designers have sought to make use of this phenomenon in the case of L-type or side valve engines in which most of the clearance space is in a dome above the valves, while the piston is ranged to come quite close to the cylinder head over a considerable part of its area. What seems to have been one of the first engines to employ this construction is a British design shown in Fig. 4 which in 1922 Ricardo stated had proved the best of all side valve engines which he had tested, so far as relative freedom from detonation is concerned. This he attributed to the turbulence and to the fact that the distance from the spark plug to the farthest point in the combustion chamber is the smallest possible.

Types of combustion chamber similar to that in Fig. 4 are found in the Herschell-Spillman, Waukesha, Lycoming and Continental designs, shown respectively in Figs. 1, 3, 6 and 7. In these, and in other similar designs which

could be cited, nearly all the clearance is in a space, usually approximating the hemispherical form, above the valves and overlapping a portion of the piston. If the piston is brought close enough to the cylinder head to create very high velocities, the gases undoubtedly have also a scouring action which not only tends to decrease carbon formation but assists in the atomization of any fuel which is in liquid form on the cylinder head.

IN the Waukesha design, shown in Fig. 3, a compression ratio of 4.75 is understood to have been employed with ordinary gasoline without any indication of detonation. The same engine is credited with a fuel consumption of slightly less than 0.52 lb. per b.hp.-hr.

In the Continental 6-Y engine, a section of which is shown in Fig. 7, a compression ratio of 4.86 to 1 is used. In this case, while the clearance is largely above the valves, the combustion chamber has a flattened form which departs considerably from the approach to a hemispherical clearance space used in some of the other designs of L-head engines shown.

In the Buda design, shown in Fig. 5, the cylinder head is a considerable distance from the piston over its entire area, while the plug is placed in a pocket well above the upper wall of most of the chamber.

High volumetric efficiency rather than turbulence has been the controlling factor in most overhead valve designs.

In respect to cooling, they are quite comparable to those already discussed, except for the Lavoie design in which the cylinder head is not water cooled. In this instance, one inlet and two exhaust valves are employed while the vaporization of incoming fuel through contact with various surfaces in the head casting is depended upon as the chief cooling medium. Some heat is, however, conducted to the water jacket through the gasket between the head and the cylinder block, while some is absorbed also by oil in the cam chamber splashing against the cylinder head on one side. In this engine the compression ratio is about 4 to 1. In the other overhead valve designs, special attention has been paid to bringing the water jacket close to the valve seats.

THE Citroen, the design shown in Fig. 12, and the Wright aircraft engine design, Fig. 13, employ two plugs per cylinder. In the Wright design the cylinder barrel and cylinder head are cast from aluminum alloy in a single piece, while the steel cylinder liner and the aluminum bronze valve seats and plug bushings are shrunk into place. Excellent cooling is understood to have resulted in this case while the life of valves and valve seats is reported to be exceptionally good, even under severe test conditions and with a compression ratio of $5\frac{1}{2}$ to 1.

It is interesting to note the heavy section of metal employed in the piston head on the Wright engine. This is a good illustration of the method employed to carry heat

Turbulence and Good Cooling Are Chief Objectives in Efforts to Avoid Trouble Arising from Detonation

from the center of the piston to the cylinder walls in an engine of $5\frac{3}{4}$ in. bore.

Among the unconventional types of overhead valve engines is the Ricardo tank engine, shown in Fig. 11. This has a compression ratio of 4.31 to 1 and is said to have been free from detonation even when kerosene was used as fuel. The engine is credited with developing a b.m.e.p. of 108 lb. per sq. in. with a fuel consumption of 0.57 lb. per b. hp. hr. It will be noted that the valves are placed horizontally opposite in the head, while the piston is a crosshead type with special facilities for cooling.

THE combustion chamber designs thus far discussed are confined to engines of quite conventional types but other designs of a more radical nature are worthy of close study. Three of these are shown in Figs. 14, 15 and 16. One of them, that of the Newcomb engine, Fig. 15, is designed to minimize rather than to encourage turbulence, the object in this case being to avoid, so far as possible, commingling of the incoming charge with residual products of combustion, thus preventing the erratic operation which usually characterizes two-stroke engines of the conventional type and minimizing the loss of charge out of the exhaust ports. The spark plug is adjacent to the inlet (transfer) valve at the end of the L where the charge is localized by part loads. The relative freedom from dilution of the charge with burnt gases is counted upon to insure rapid combustion. Attention should be called to the gradually expanding neck which joins the L with the main part of the clearance space and the relatively small area of contact between new and spent gases at light loads.

A single cylinder $4\frac{1}{2} \times 5\frac{1}{2}$ in. engine of this design is understood to develop $13\frac{1}{2}$ b.hp. at 1100 r.p.m. Its economy at light loads is considerably better than that of most conventional engines. A light car equipped with this engine is said to make regularly from 65 to 80 m.p.g.

RICARDO has experimented successfully with the four-stroke localized charge engine shown in Fig. 14. This has two inlet valves, one for air only and the second, which is an automatic type, for a rich mixture which enters the bulb in which the spark plug is located. The mechanically operated inlet is arranged to open late, at about 20 per cent of the stroke, so that most of the charge is presumed to remain in the bulb until ignition takes place. At this moment there is violent turbulence in the bulb due to the air being forced in through the neck on the compression stroke. Following ignition the flame rushes out and mixes with the excess air in the bulb, thus giving complete combustion. The power output can be varied by controlling the quantity of fuel fed or by varying the percentage of total charge which enters the bulb.

With this unusual shape of combustion chamber high economy was secured, especially at part load, due again in part to the substantially constant compression and the

excess air which can be used without interfering with combustion.

It has, however, proved impossible to avoid a small zone of inefficiency somewhere within the power range. Ricardo states that everything appears to depend upon the shape of the combustion chamber below the bulb, the shape and size of the neck connecting the bulb with the chamber and the position of the spark plug. In this engine the exhaust is reported to resemble deep breathing rather than a sharp report. A sister engine, similar in all respects except for the bulb arrangement on the head, which, like the engine in question, is used daily in driving machinery, requires reseating of the exhaust valve about once in two months, while with the special head no such repair work has been required in twenty months of similar service, and no carbon accumulations are in evidence.

The maximum b.m.e.p. of the localized charge engine with a 6.5 to 1 compression ratio is 80 lb. as compared with 100 lb. for the sister engine. With aromatic-free gasoline no detonation occurs.

WHILE these designs of combustion chamber have yet to see any wide commercial application, there appear to be great possibilities, especially from the standpoint of economy, in engines of the constant compression, localized charge type.

The Peugeot-Tartrais two-stroke surface ignition engine, the combustion chamber of which is shown in Fig. 16, has been developed for truck and bus service in France. This engine, which has been built in two-cylinder units of 4.7 in. bore and 5.9 in. stroke, is designed for direct fuel injection and a high degree of turbulence in the mixture just prior to ignition. Since this engine is a hot surface type the combustion chamber is unjacketed and is intended to operate at a temperature sufficiently high to produce auto-ignition after the engine has been started by the use of the electrically heated resistance coil of the igniter.

It will be noted that the piston head is provided with a steel deflector against which fuel from the injection valve impinges. The narrow passage between the piston head and its deflector and the neck result in exceedingly high turbulence at the end of the compression stroke.

THIS engine is said to be capable of operating on almost any liquid fuel and is credited with an economy of 0.4 lb. fuel per hp. hr. under full load and 0.48 lb per hp. hr. at one-quarter load. The engine is fitted with a double acting scavenging pump cylinder from which air is forced into the working cylinder. The combustion chamber is made from a chrome nickel alloy and is so designed as to expand and contract with change in temperature.

This is another example of a combustion chamber design in which the primary aim is high economy on a low grade of fuel.

COMBUSTION CHAMBERS—Side Valve Type

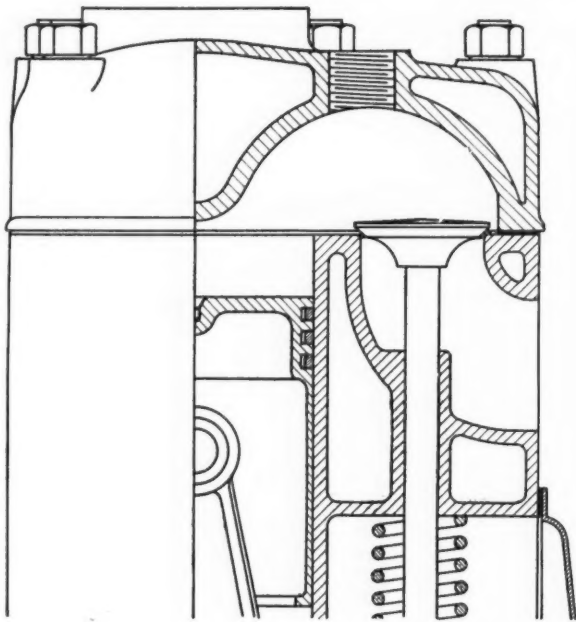


FIG. 1

HERSCHELL-SPILLMAN (Fig. 1)

Four-Cylinder $3\frac{1}{4} \times 4\frac{1}{2}$ in.; 149 cu. in. piston displacement. Compression ratio, 4 to 1.

A recent American design in which the clearance space is in the form of a dome over the valves.

The piston is of cast iron and comes within approximately 3-16 in. of the head over part of its area.

Care has been used to bring the water jacket completely around the circumference of the valve seats in order to facilitate valve cooling.

This engine weighs 300 lb. and is reported to develop approximately 80 lb. brake m.e.p.

TRIUMPH (Fig. 2)

Four-cylinder $2\frac{1}{2} \times 4\frac{3}{8}$ in.; 86 cu. in. piston displacement.

A British design attributed to Ricardo and intended for light car service.

The head is not designed to promote turbulence as is the case with some earlier Ricardo designs.

The piston is an aluminum slipper type. Valves are "masked" or countersunk to enable the use of a more favorable cam profile.

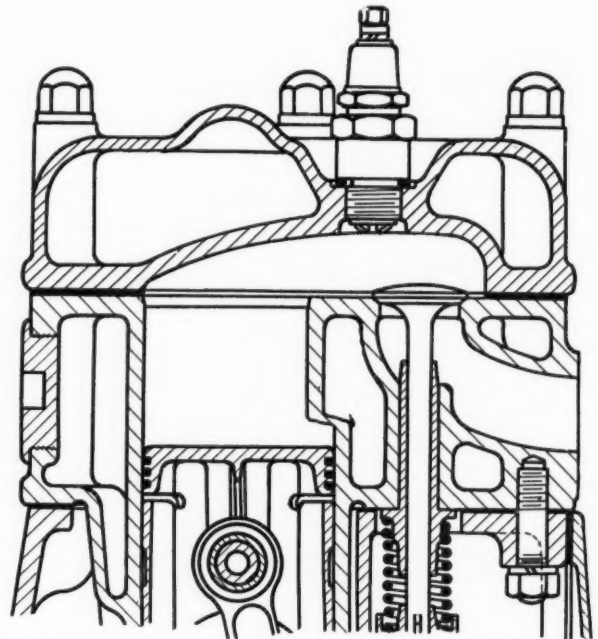


FIG. 2

WAUKESHA, MODEL F U (Fig. 3)

Four-cylinder $4 \times 5\frac{3}{4}$ in.; 289 cu. in. piston displacement. Compression ratio 4.56 or 4.75 to 1.

Clearance space is largely over valves while piston comes within about $\frac{1}{8}$ in. of the head over most of its area thus producing a high degree of turbulence. Hot spots are said to be eliminated. Aluminum piston has thick section head designed to promote rapid flow of heat through rings to cylinder walls.

Engine is reported to develop 98 lb. brake m.e.p. at 900 r.p.m., to consume 0.517 lb. fuel per b.hp.hr. and to be free from detonation.

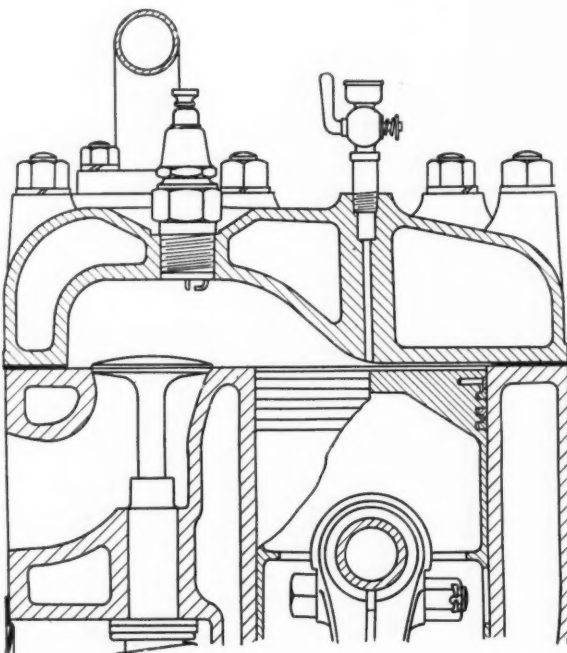


FIG. 3

COMBUSTION CHAMBERS—Side Valve Type

RICARDO (Fig. 4)

11.9 hp. (rating) engine developed for tank service.

This type of combustion chamber proved the best of all the side valve designs which Ricardo tried due to the high degree of turbulence and fact that maximum distance from point of ignition to farthest point in combustion chamber is small as possible. Ricardo says last mentioned factor is controlling one in respect to detonation.

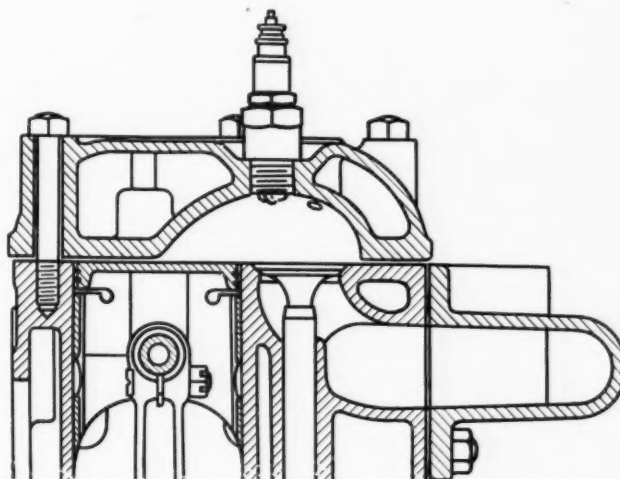


FIG. 4

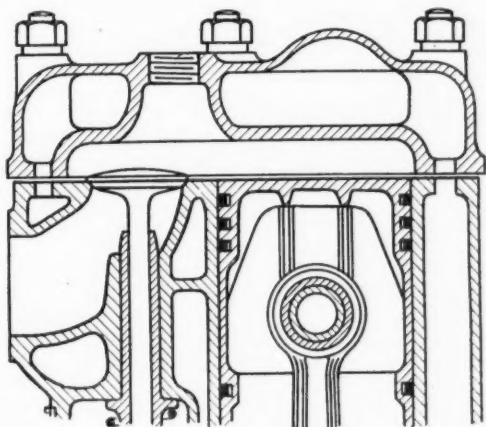


FIG. 5

BUDA (Fig. 5)

Four-Cylinder $3\frac{3}{8} \times 5\frac{1}{8}$ in.; 211 cu. in. piston displacement. Compression ratio 4.35 to 1 (80 lb. gage). Designed especially for light truck service. Note ample jacket space providing water circulation around entire circumference of each valve.

Pistons are grey iron castings provided with cooling ribs. Piston head does not come close to cylinder head and plug is located in a pocket well above the upper wall of combustion chamber.

LYCOMING, MODEL C. T. (Fig. 6)

Four-Cylinder $3\frac{3}{4} \times 5$ in., 220 cu. in. piston displacement. Compression ratio 4.12 to 1.

Clearance space is mostly over valves, while piston comes within about $\frac{1}{4}$ in. of head thus tending to produce considerable turbulence. Water jacketing extends entirely around all valves.

This engine is reported to develop 43 b.hp. at approximately 2000 r.p.m. and a maximum torque of 125.8 lb. ft. at 1100 to 1500 r.p.m.

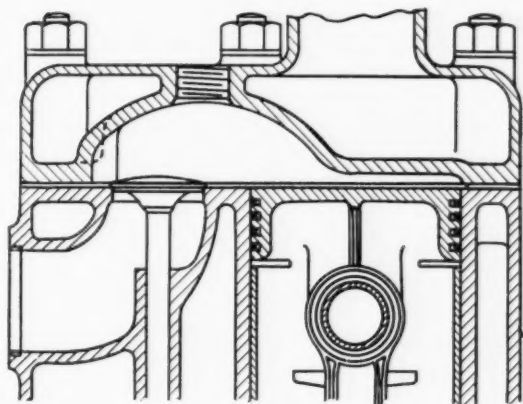


FIG. 6

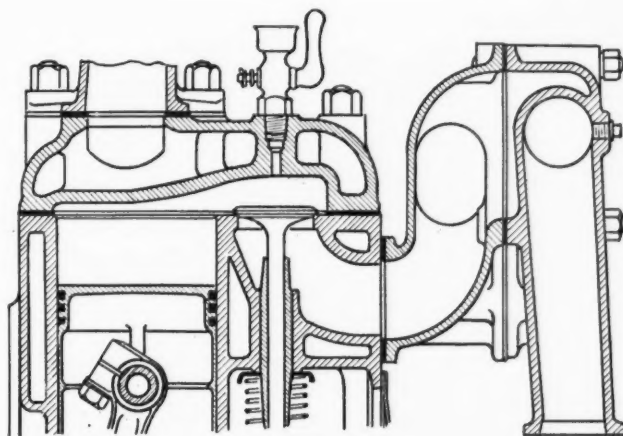


FIG. 7

CONTINENTAL, MODEL 6-Y (Fig. 7)

Six-Cylinder $3\frac{1}{8} \times 4\frac{1}{4}$ in.; 195.6 cu. in. piston displacement. Compression ratio approximately 4.86 to 1.

While most of the clearance space is over the valves the combustion chamber is a flattened form. Jacket water is brought close to the valve seats throughout their circumference.

Reported to develop a maximum of 50 b. hp. at 2600 r.p.m. Maximum torque is given as 118 lb. ft. at 1400 r.p.m. (equivalent to 91 lb. b.m.e.p.). Engine weighs 470 lbs.

COMBUSTION CHAMBERS—Overhead Valve Type

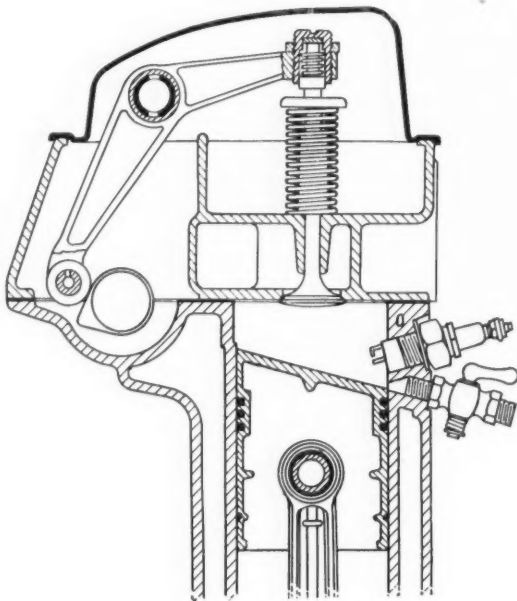


FIG. 8

LAVOIE (Fig. 8)

Four-Cylinder $3\frac{3}{8} \times 5$ in., 179.8 cu. in. piston displacement. Compression ratio approximately 4 to 1. One inlet and two exhaust valves seating in unjacketed head. Chief factor in cooling head is incoming charge which is directed against walls of exhaust ports, but oil from cam chamber jacket below gasket assists in cooling one side of head. Sparkplug is in water jacketed wall. Piston is of aluminum and has inclined head intended to prevent piston slap.

VAUXHALL (Fig. 9)

Four-Cylinder $3\frac{3}{4} \times 5\frac{1}{2}$ in., 242 cu. in. piston displacement. Compression ratio 4.25 to 1. Water circulation between cylinders and head is through external connections so that head gasket, which is of aluminum, is required to hold cylinder pressure only. There are two 2 in. o.d. valves per cylinder. Peak of horsepower-speed curve is at 2000 r.p.m. at which speed the engine is said to develop 60 brake hp.

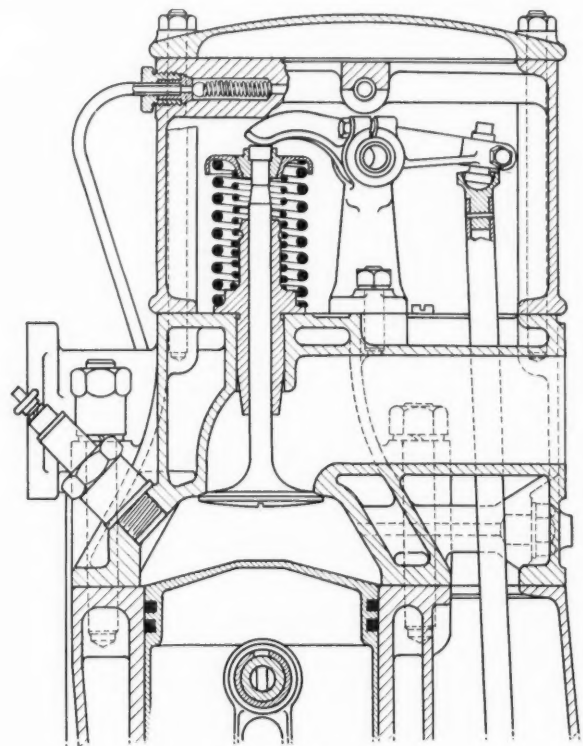


FIG. 9

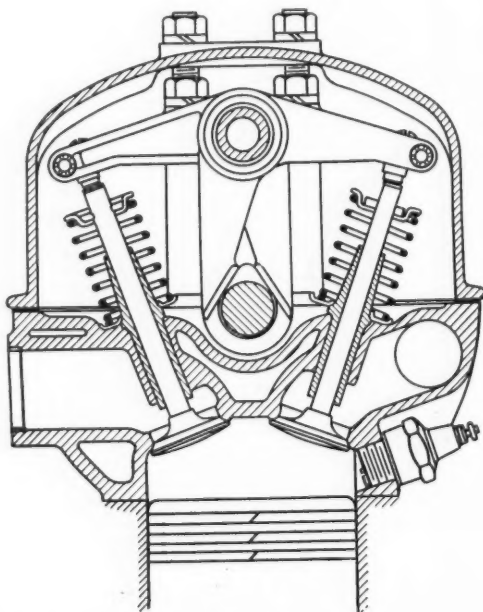


FIG. 10

HOLT, MODEL T-35 (Fig. 10)

Four-Cylinder $4 \times 5\frac{1}{2}$ in., 276.5 cu. in. piston displacement. This is an American tractor engine the design of which is attributed to P. E. Holt and E. G. Hall. The inclined valves are water jacketed throughout their circumference and liberal water space is provided entirely around the combustion chamber. The engine is credited with developing 28 b.hp. at 1000 r.p.m. which is equivalent to a brake m.e.p. of 80 lb. per sq. in.

COMBUSTION CHAMBERS—Overhead Valve Type

RICARDO 225 HP. TANK ENGINE (Fig. 11)

Compression ratio 4.31 to 1.
Heavy duty engine with horizontally opposed valves. Ricardo considers this is a remarkably efficient form of combustion chamber. The engine is said to be free from detonation even when kerosene is employed as fuel and a compression ratio of 4.31 to 1.

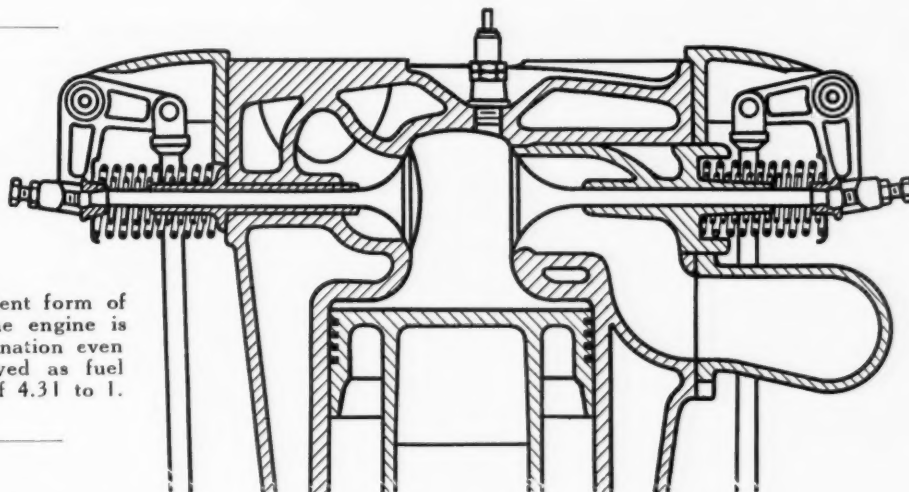


FIG. 11

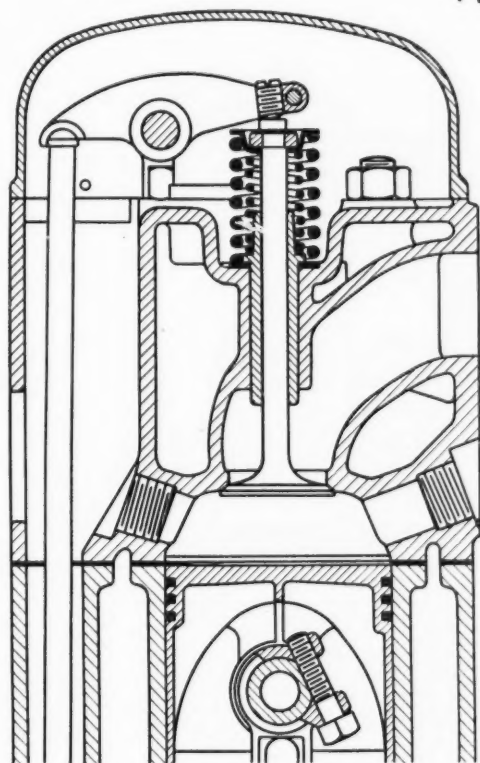


FIG. 12

CITROEN (Fig. 12)

A French design credited with exceptionally high economy. A car equipped with this engine is reported to have won French fuel economy tests. The engine is said to have a compression pressure of 86 lbs. per sq. in. and to develop 35 hp. at 3600 r.p.m. Note that there are two spark plugs per cylinder and that the piston head is quite thick.

WRIGHT-NAVY (Fig. 13)

Twelve-Cylinder $5\frac{3}{4} \times 6\frac{1}{4}$ in., 2596.8 cu. in. piston displacement. Compression ratio $5\frac{1}{2}$ to 1. This engine, developed primarily for use in Navy seaplanes, has aluminum cylinders with integral head and jacket walls. Steel liner and aluminum-bronze valve seats and spark plug bushings are shrunk in place. Note heavy domed aluminum piston head and use of two plugs per cylinder. With an inlet manifold purposely somewhat throttled this engine is credited with developing 500 b.h.p. at 1800 r.p.m. with a fuel consumption of 0.48 lb. per b.hp. hr.

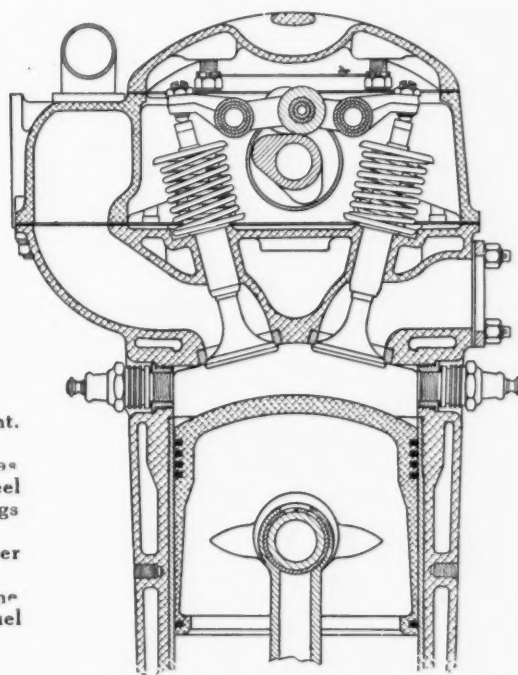


FIG. 13

COMBUSTION CHAMBERS—Constant Compression Type

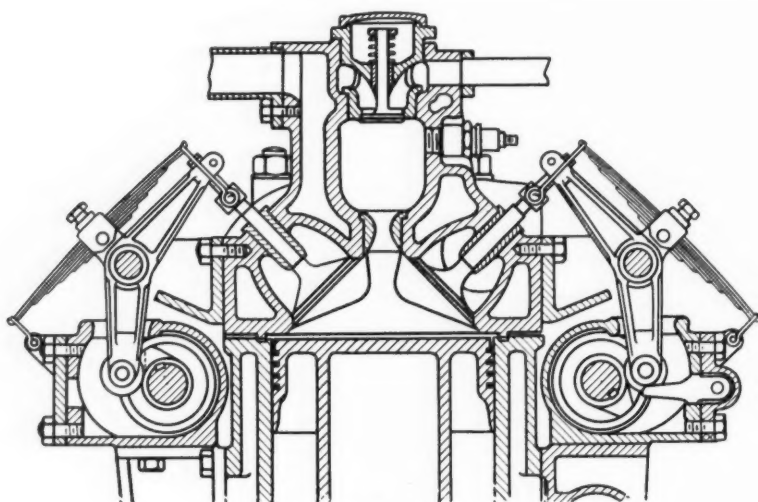


FIG. 14

RICARDO, LOCALIZED CHARGE (Fig. 14)

This engine has two inlet valves; that in bulb admits over-rich mixture which, when ignited, rushes into main clearance space where combustion is completed. Second inlet valve admits pure air only. With 6.5 to 1 compression ratio and aromatic-free gasoline there is said to be no detonation and no deposit of carbon.

NEWCOMB (Fig. 15)

Single-cylinder $4\frac{1}{2} \times 5\frac{1}{2}$ in. two-stroke. 87.5 cu. in. piston displacement. Compression ratio 3.8 to 1. Localized charge, constant compression engine, designed to minimize turbulence and prevent commingling of fresh charge with residual products of combustion. Spark plug located in L. adjacent to admission valve. By minimizing commingling rapid combustion is assured. The engine is credited with developing 13.5 b.h.p. at 1100 r.p.m.

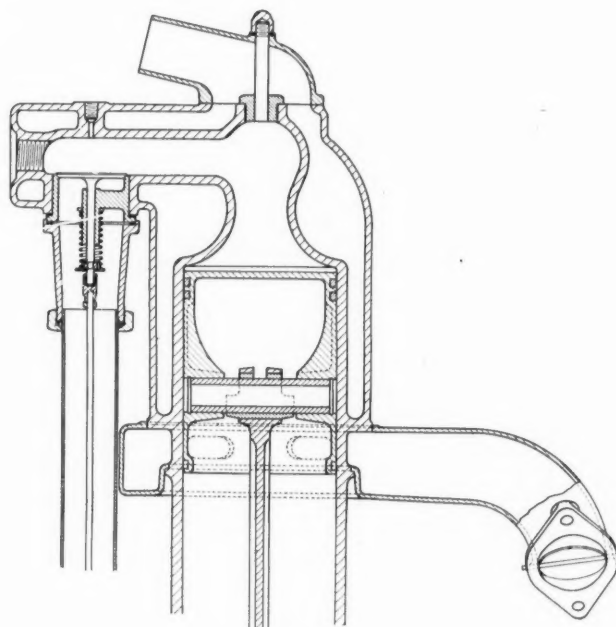


FIG. 15

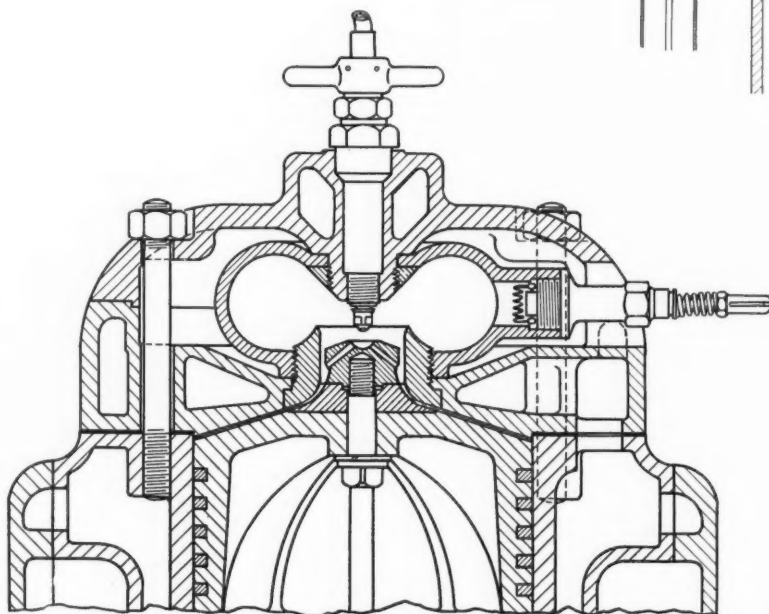


FIG. 16

PEUGEOT-TARTRAIS (Fig. 16)

Two-cylinder 4.7×5.9 in. two-stroke. A fuel injection engine designed for surface ignition accompanied by high degree of turbulence. Combustion chamber of chrome nickel alloy and is unjacketed and is to be free to expand with change in temperature. Deflector attached to piston head assists in creating turbulence.

Said to be capable of using any liquid fuel.

Refinement of Tops for Open Models Will Help Foreign Sales

Engineers can help develop larger overseas markets for cars by improving quality and appearance of coverings. Permanent or semi-permanent panels with glass lights are desirable. No radical changes needed in design. Battery ignition progresses.

By J. D. Mooney

Vice-President, General Motors Corp., and President, General Motors Export Co.

FOREIGN purchasers have already been pretty thoroughly sold on American automobile engineering and it is not necessary to adopt radical structural changes to please them. There is, however, one direction in which much progress can be made without serious difficulty. That is in the refinement of tops and year round comforts for open models.

Export demand for closed cars has always been somewhat limited because of their higher price. Consequently, if we can give overseas buyers what they want in the way of open models without a material increase in cost, we shall be doing a good job of merchandising. It would strengthen and help to maintain the home market for open cars as well.

Better Phaeton Tops Needed

Americans are accustomed to driving with the top up while people in most other countries prefer to drive with it down. Designers should consider giving the overseas customer tops which will keep the water out in bad weather and afford protection from the sun on fair days. This does not involve any engineering difficulty and is something which would have a strong appeal in the foreign automotive field.

It cannot be denied that a good many of our American open models are somewhat unsightly and far from being weather-proof when the side curtains are in place. An open car which would be as smart in appearance with the curtains in place as it was without them would require little selling in most overseas markets. Permanent or semi-permanent panels with glass lights are desirable, especially when a non-folding top is employed. There should also be an easily opened window for the driver. A heater to keep the interior comfortable would be helpful in non-tropical countries. Some means should be provided for making curtains more readily accessible and more easily attached.

Appearance a Big Sales Help

Open cars of this character, which would be little more expensive to make than the ones now being turned out, probably would do more than anything else to break down sales resistance. They would bring many people into the market who are not buying today, because they cannot afford closed models and they do not like the top equipment on the lines now available. It must not be forgotten that our overseas cousins are just as much concerned with external appearance as with what is inside. They seriously object to sloppy looking curtains.

While the trend at home is strongly towards the closed car, our production facilities are geared up for the open

model. Any improvements in body design which would make the open model more readily salable overseas would have exactly the same effect in the domestic market. Constructive developments in this direction, therefore, would serve a double purpose. A car of a semi-convertible type, equally good looking and comfortable in all seasons, would brace up the home demand and also would expand export sales.

Women Demand Comfort

It is characteristic of all women that they want their belongings neat and trim and good looking. They also demand comfort. These two factors probably have had more than anything else to do with the drift towards closed models. Most men prefer to drive open cars in decent weather, but they compromise by getting what the women of their families want. If we had open cars which were warm and bright and snappy looking when the curtains were in use I believe they would satisfy a great many women who now insist on coupés, sedans and limousines.

Some of the points about American cars which endear them to foreign buyers are their wealth of power, easy acceleration, roomy and comfortable bodies. The springing generally is very satisfactory on the somewhat mediocre road conditions frequently found in some countries. American automobiles stand up well under the hard banging they get.

Battery Ignition Making Progress

Battery ignition is making fair progress overseas but there are still a good many places in the distributing system where buyers are very skeptical about it. A magneto permits cranking and insures ignition. Battery ignition is superior from an engineering point of view, and standardization on battery ignition can be made possible by the use of excellent batteries, and the further extension of battery service, particularly in the small towns and country districts.

Taking world markets as a whole, no material changes in design are essential to get business in these markets. If a car gives good service, buyers are not so much concerned about its technical details. They want power, endurance, reasonable fuel economy, comfort and good appearance in all kinds of weather. Given these factors sales will increase.

Given the characteristics I have enumerated, plus improvements which are constantly being made in our factories, almost as a matter of routine, the American car will continue to give entire satisfaction in the export market.

Manufacturing Methods Hold Attention of Body Engineers

Design is being adapted
to needs of production;
experiments in process

By J. Edward Schipper

BODY engineering development at this time is chiefly in improving manufacturing methods. A big Detroit body plant, for example, is conducting a production experiment which may mark the introduction of a new era in automobile manufacture. This concern is beginning to build bodies by a true progressive system. In place of the old stationary buck arrangement upon which four or six men assembled the framework of a body, the buck in this shop travels along a conveyor chain just as the chassis travels along the chassis assembly line. Starting with the bare buck at one end of the line, the framing and paneling operations are completed, step by step, until the finished bodies, ready for the paint shop, drop off the bucks at the end of the line.

Until recently, it has been costing this concern more money to do the work in this way than it would in accordance with the old-established method of manufacture. A great many unforeseen difficulties came up which at first prevented the undertaking being a commercial success. The possibilities, however, are so evident and the ultimate saving will probably be so great that this concern undoubtedly will keep on with the progressive system.

Experiments Carried on in Secret

All of these experiments have been conducted very privately and details about the individual steps taken in working out this method of manufacture have been carefully guarded. Body men generally, however, are informed as to the major aims and are intensely interested because they think that the big changes in body-building methods made during the past twelve months are nothing to what may be expected during the next two or three years.

There are several important reasons behind the changes in body-manufacturing methods. In the first place it is impossible to build bodies economically on a large scale by methods used in the small-body shop. The cost of hand trucking bodies and partial assemblies alone would be sufficient to consume most of the profits of the business. The tremendous investment in space alone adds heavily to the overhead. Space required to manufacture does not increase directly as the output in the metal working business. The possibility of close packing, ability to use machines of greater productivity and a great many other elements enter to cut the ratio between the factory area and the output.

PROGRESSIVE assembly is now being used in several body plants. Sectional construction to reduce shipping costs is another recent development. Various other experiments are being tried out with a view to reducing body production costs.

This article reviews recent developments in body engineering and indicates probable future trends.

In the manufacture of bodies by the usual methods, however, it is impossible to nest the parts in storage. The space required by one body multiplied by the number of bodies produced will give the area required by the production schedule. When the movement of complete doors, roofs, rear panels, side panels, dash assemblies, etc., is considered, it is easy to see how factory area and trucking costs can run up to tremendous figures as soon as a shop begins heavy production. A real progressive system seems to make possible drastic cuts in both factory space and trucking, the latter being practically eliminated.

Finishing is another big problem in automobile body production. It is being attacked simultaneously with that of material handling, but with less success up to the present time. After the metal has been applied to a wood body in accordance with the established system of body manufacture, the entire paneled body must go through a painting process lasting all the way from five to eighteen days and sometimes even longer than this. Here, again, tremendous space is required and a great amount of trucking is necessary with the result that the finished product must be comparatively expensive.

The same two ideals are sought in body finishing as in body assembly. These are:

1. Completion of the job and removal from the plant in minimum time.
2. Elimination of hand trucking.

Paint chemists are now trying to make two or three discoveries which would cut the cost of body finishing very materially. One of these is an enamel which can be prepared in any color and which will bake at a temperature of somewhere between 200 and 300 deg. One concern now has on the market a low temperature black enameling process which is claimed to be suitable for wood framed bodies.

Progressive Assembly Has Merit

The system assembling the wood frame alone on one progressive line and the panels on another has considerable merit. The painted or enameled panels can be screwed to the assembled wood frame at the proper point; the trimming, upholstery and moldings can be put on, the bodies dropped onto the chassis and shipped. A method of this kind cannot be used, of course, if bodies are to be shipped any great distance from a body factory to a chassis plant. The loss in damaged body finish requir-

ing repainting would be tremendous. Many body manufacturers believe, on the other hand, that it is going to be possible to finish the individual panels before they are placed on the body frame. This method is being tried experimentally in the shop mentioned at the beginning of this article. Whether or not it will be a commercial success still remains to be seen, but it has given much promise.

It has been frequently suggested that panels could be painted and all but finish varnished before assembly, after which they could be given a rub and the finish varnish applied without much risk of damage to the finish varnish coat. One body manufacturer suggests assembly of bodies in knocked-down form with the panels in place, painted and all but finish varnished, and shipment by freight at a considerable saving over the method of shipping the entire body.

Knocked-Down Bodies Offer Advantages

Whether or not this can be done commercially is a subject which will probably be settled by trial. This same concern is now supplying brougham bodies in knocked-down form to a car manufacturer nearly 200 miles away. Thirty-five bodies are loaded into a freight car which held only seven assembled units. The car factory, when it receives these knocked-down bodies, puts them together and sends them through the usual schedule of painting operations. If the painting could be done while the bodies were still knocked-down, the time the completely assembled units remain in the plant would be reduced materially.

Use of progressive assembly methods often is difficult because the bodies are not designed for such a manufacturing system. Insistent demand on the part of dealers for a lower price differential between open and closed models has been responsible for complete overhauling of closed-car design during the past two years. The response of the buying public to lower closed-body prices has been so remarkable that many concerns selling cars for more than \$1,500 are beginning to consider open-car production as secondary. In fact, some of the sales managers of cars in this price class are making unusual efforts to unload open cars before warm weather is over. One concern has stated that open cars in future will only be built on order.

Simplified Construction Makes Saving

To reduce the cost of body manufacture, on the closed jobs particularly, simplified construction is necessary. This has been accomplished in the so-called coach type of bodies by elimination of practically all curves and rounded corners. Another means of saving has been the discarding of certain traditional forms of finish. The old coach builder, from whom the body manufacturer secured his original ideas, would not have tolerated an exposed screw head, for instance, in his completed body. The coach type of today, however, is finished with plainness and simplicity. No attempt is made to cover screw heads where such a procedure would be expensive. Other savings accrue from the use of two doors in place of four, felt liners in place of the usual window runners, with the glass operating between two fixed lining strips of felt.

A great deal of expensive labor is saved by so designing the body that it can be put together in sub-assemblies, and additional economy is secured by making as many parts on the body of the same dimensions as possible. All four window frames, for instance, are of the same size, making the four pieces of glass for the side windows identical. Consequently, there is no fitting of left and right in putting the bodies together. Detachable

upholstery is another economy feature which is being utilized not only in the coach type of today but in other bodies as well. Detachable upholstery can be assembled outside the body and, consequently, workmen do not have to work in a cramped position.

The fabric body is another experiment which is exciting interest among both body builders and dealers. This type of body is being built as a metal panel type with the fabric shellacked to the steel panels and also in the form of a body entirely covered with fabric over a foundation of wire and buckram fastened to the conventional wood framing.

The wearing qualities of the fabric materials, as illustrated by their use for open car and California tops, have proved satisfactory. When fabric is put on over wire mesh, the wire is applied directly to the frame work. The wire employed in the experimental body, made up about the time of the last New York show, was a No. 19 gage, two meshes to the inch and fastened with staples. Buckram is fastened over the wire, one layer of cotton wadding being placed between the wire and the buckram. The frame work is double rabbetted, one rabbet being for the wire and the other for the buckram. The rabbet for the buckram is wider so as to have it cross the joints, permitting it to be nailed beyond the edge of the wire. The fabric used is designed to be an exact duplicate of the Landau leather used in the carriage days to trim the leather Victoria tops.

Fabric Covered Body Proves Practical

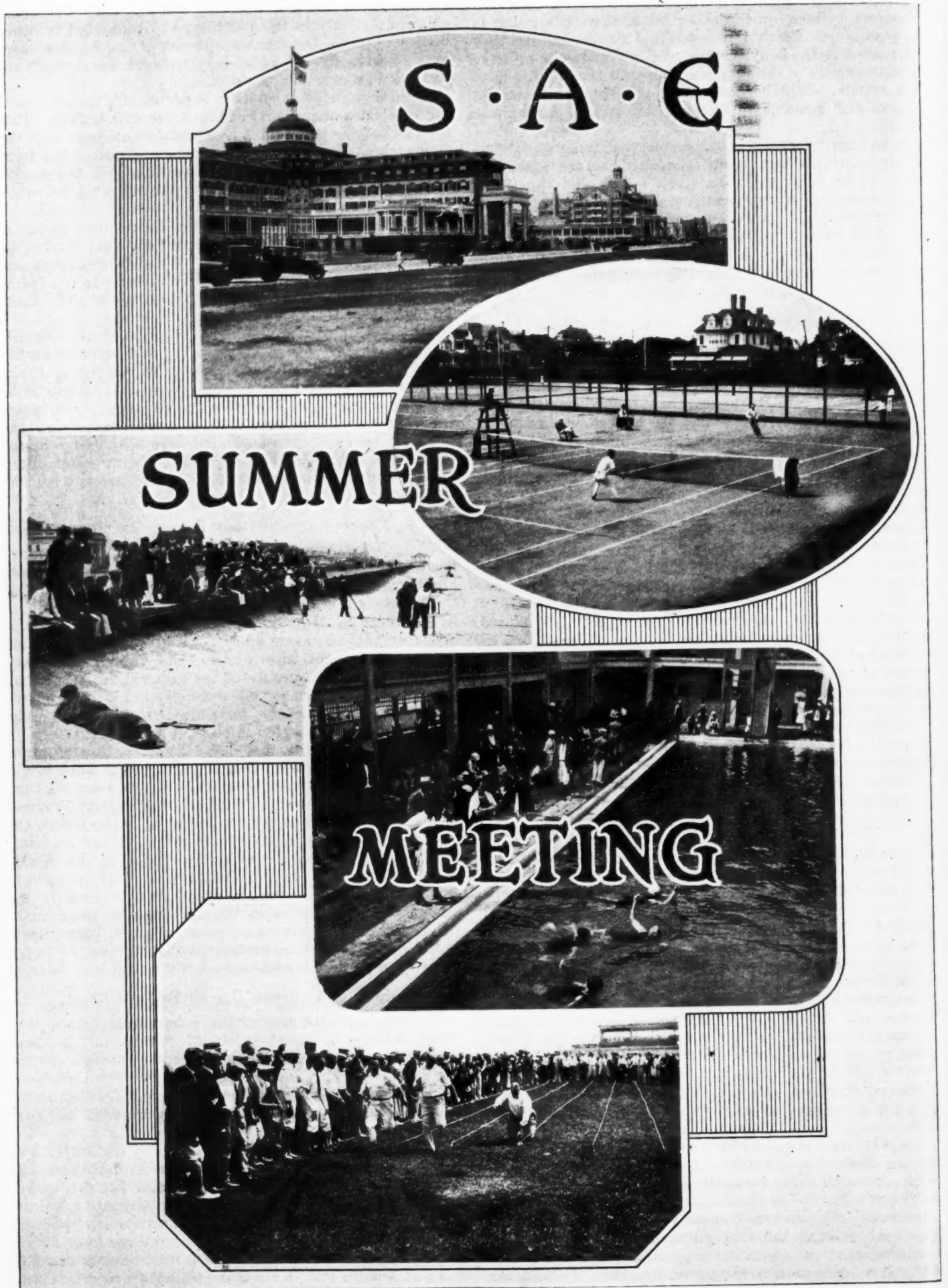
The fabric covered body which was shown last January has been on the road now for about 4000 miles under very close observation. Early fears that the appearance of the fabric would deteriorate seem to have been groundless. There is, of course, a merchandising angle to the situation just the same as there was to the introduction of steel disk wheels or any other innovation which greatly changed the appearance of the finished product. Considerable reluctance is encountered on the part of the general public to accept anything which differs materially from a product to which it is accustomed.

From this brief summary of developments in automobile bodies, it is evident that changes in the near future probably will be greater in manufacturing methods than in engineering or design. Certain engineering changes probably will be required, however, to really adapt the body to production methods. Some such developments have already become quite noticeable in up-to-date bodies, particularly the use of pressed steel in place of wood. The all-steel body will continue to grow in use among the manufacturers who produce in large quantities. The expensive equipment required, particularly in the press and die investment, will preclude the possibility of a more extended use of these bodies.

More Widespread Use of Pressed Steel

Greatly increased use of the pressed steel body may result from willingness of manufacturers in the lower price classes to standardize on certain forms of rear panels and possibly even cowl shapes. If this were done the cost of the dies could be split among several manufacturers adopting such a standard rear panel and cowl shape.

There is considerable argument against the sacrifice of individuality in the exterior appearance of the car and many engineers believe we have gone as far as we dare go from the design standpoint in standardization. However, the saving may prove to be so attractive, at least for open car work, that a sufficient number of car manufacturers in the lower price class may be interested to make this more than a mere possibility.



Balloon Tires and Four Wheel Brakes Hold Engineers' Interest

Eagerly discussed at S.A.E. Summer Meeting. New braking system endorsed generally. Opinion somewhat divided on merits of large section pneumatics. Design details considered. Fuel session brings forth new data. Crane nominated for president.

GENERAL belief that four-wheel brakes are certain to be used widely in the near future and considerable difference of opinion regarding the advisability of immediate adoption of balloon tires were outstanding developments at the Summer Meeting of the Society of Automotive Engineers, held at Spring Lake, N. J., June 19 to 23. Fuel research and headlight glare came in for their share of comment, however.

While consideration of technical subjects probably held first place in the interest of the 750 engineers who attended the meeting, sports easily came second. Competition was unusually keen in golf, tennis, trap-shooting and in the field events. The ocean, abetted by intensely hot weather part of the time, lured many enthusiasts into the surf.

Henry M. Crane was nominated as president of the Society for 1924. By naming Crane to lead the engineers next year, the nominating committee made a choice that was popular with the members. Crane has been active in affairs of the society for many years. He has been a member of the council for some time and is first vice-president at present. Other officers nominated were:

E. A. Johnston, first vice-president; W. R. Strickland, second vice-president, representing motor car engineering; J. F. M. Patitz, second vice-president, representing tractor engineering; H. L. Pope, second vice-president, representing aviation engineering; W. C. Ware, second vice-president, representing marine engineering, and T. B. Fordham, second vice-president, representing stationary internal combustion engineering.

The following men were nominated as councillors for the term 1925: J. H. Hunt, A. K. Brumbaugh and M. P. Rumney. C. B. Whittelsey was re-nominated treasurer.

Technical sessions were fewer in number than in past years, but the papers and discussions easily made up in interest what they lacked in volume. More than 200 men sat through the entire evening session devoted to large section tires despite terrific heat and limited ventilation facilities. About the same number listened with great interest to the four-wheel brake discussion the following morning under similar weather conditions.

Four technical sessions, a business meeting and a standards committee meeting were held. The interest

evoked through the selection of live topics and efficiently managed sessions was such as to indicate complete success for the new policy of more time for play and more work in fewer hours.

Engineers are taking more interest in details of design than ever before. The strong emphasis once laid on engines has been shifted to other parts of the car. This fact was evidenced not only by the subjects chosen for the various sessions, but also by informal conversations of men at the meeting.

Balloon tires and four-wheel brakes came in for major attention, of course, because they were on the official program and because demonstration equipment was brought to Spring Lake for inspection by the S. A. E. members. Spring shackles, top design for open models, wheels, steering gears and other topics, however, were talked about frequently at luncheon and on the verandas.

Many of these subjects which are interesting the engineers have to do with safety. One of the chief arguments in favor of four-wheel brakes is that they tend to reduce accidents, while a principal objection to immediate adoption of large section tires is the uncertainty of their performance at high speeds. Keen interest was shown also in the headlamp glare discussion, as it was generally believed at the meeting that better headlamp provisions are absolutely necessary if drastic legislative action is to be avoided.

The attention being given to various refinements of the chassis does not mean any cessation of work on engine problems. It simply indicates a

shifting of emphasis in engineering work and a realization of the importance of certain phases of design previously neglected to some extent.

The balloon tire session, at which James E. Hale read a paper, showed this Firestone representative to be more enthusiastic about the immediate adoption of the new tires than were engineers of other tire companies. The advantages of the large section type from the standpoint of easy riding were generally admitted, but Hale's contention of lower fuel consumption and safety were disputed by some other engineers who also have been experimenting with balloon tire.

Four-wheel brakes received almost unanimous endorsement at the session devoted to discussion of this mech-



Henry M. Crane, nominated for president of the S. A. E.



Col. H. W. Alden, president of the
S. A. E.

anism, but there seemed to be a strong undercurrent of opinion leaning toward a very careful examination of the entire situation before advocating their general adoption. Many engineers who are thoroughly sold on the four-wheel brake idea in general pointed out the need for further development in design, both of brake mechanisms and of other parts of the car. It was agreed that certain units must be strengthened materially to withstand the extra stresses set up by the use of brakes on all four wheels.

Some prominent engineers believe, for example, that well-designed two-wheel or transmission brakes will provide all the braking capacity necessary, and that efforts along this line might be more profitable than general adoption of four-wheel designs at this time.

Engineers Urged to Use Standards

Nearly a hundred members listened to R. N. Falge's paper on headlamp glare, and the subsequent discussion indicated clearly the need for extensive work along this line. Dr. C. H. Sharp made a strong plea for the support of factory engineers in conforming to the regulations set up in many States as a result of cooperative re-

search on the part of the S. A. E., the Bureau of Standards and the Illuminating Engineering Association.

The general opinion of engineers present was that the headlamp situation could be improved materially if the factory purchasing agent were not allowed to assume the functions of the engineers in selecting such equipment.

Professor Upton's paper on factors which govern the optimum spark advance in automotive engines came in for the largest amount of discussion in the fuel session. There was much interest in the effect of turbulence in this connection. There is apparent a wider interest in this important phenomenon and its effect on other factors as well as indications that its significance is rapidly coming to be more fully realized.

The reports of fuel research work contained much food for study, but were so similar to earlier reports in general character that they did not elicit much discussion. The fact that engine temperature has an important bearing upon the troublesome tendencies of present-day fuels to dilute crankcase lubricants was among the more important results which the research reports brought out.

Recreation Enjoyed

Recreation activities were given a more prominent place on the program than ever before, and consequently opportunities were increased for making new friends and learning new facts. The plan of holding some evening meetings and devoting most of the days to sports met with the hearty approval of the members, and the general opinion was expressed that the technical sessions were made more valuable as a result.

Sports included golf, tennis, field events, trap shooting, horseshoe pitching, bridge and dancing. New champions were crowned in many events and competition was keen throughout the various tournaments.

The place chosen for the meeting provided excellent facilities for sports. The seashore seemed popular with the Western as well as with the Eastern members. The attendance was extremely large and the representation was well distributed among the various sections. This was especially gratifying as there was some fear before the meeting that the numbers from the West might be small because the Atlantic seacoast had been selected for the gathering.

A noticeable increase in section rivalry in athletics was a pleasing feature. This should help to increase attendance and interest at future gatherings.



Geo. C. Lees, W. I. Ralph, Geo. A. Kraus,
D. W. Meigs



L. Clayton Hill, H. W. Slauson, H. R. Corse,
O. A. Parker, George Briggs

All Engineers Not in Entire Accord on Value of "Balloon" Tire

Some believe Hale of Firestone too optimistic in contention they will give increased mileage per gallon of fuel. Lively discussion follows paper. Thatcher tells of puncture liability.

J. E. HALE, of the Firestone Tire & Rubber Co., in his paper on large section, low pressure tires, showed a profound belief in their good qualities and a decided optimism concerning their general adoption in the near future. He indicated that the Firestone company is about to start marketing these tires and he suggested certain standard dimensions which he considers desirable.

The paper was well received and many engineers concurred in most of the views expressed. Certain of Hale's conclusions were questioned quite strongly, however, but other engineers who have been studying the new tire, P. S. Thatcher of U. S. Tire Co. in particular, took exception to Hale's conclusion that increased miles per gallon of fuel are obtained through the use of balloon tires. Rolling resistance is greater, Thatcher said, punctures are likely to be more frequent, and danger from accidents at high speed is increased. Thatcher's views are expressed fully in an article which appears on other pages of this issue.

Others expressed the view that Hale is too optimistic regarding the new tire, but admitted that it has many advantages. Charles L. Nedoma of the Cadillac Co., for example, said that he is apprehensive concerning the performance of low pressure pneumatics at high speeds. It has been found that they puncture more readily than the high pressure type. In one test there were six punctures in 3500 miles of service.

Ernest Wooler, of the Cleveland Motor Car Co., who drove to the meeting in a car equipped with balloon tires, said that low pressure pneumatics do materially decrease skidding, improve riding qualities and enable higher speed in rough going. Changes in the steering system, which are easily made, render the car as easy to steer as with conventional tires. The tendency of the tire to raise dust and throw small stones or gravel is something of a problem.

Need for Better Cushioning Recognized

Paul W. Litchfield, of the Goodyear Tire & Rubber Co., said that the need for better cushioning is well recognized but that it is yet a question how far it is wise to go in this direction. He took the view that rim widths suggested by Hale probably give too narrow a base and thereby tend to increase side rolling. Experience with narrow base tires in the past has been unfavorable and has forced the use of wider base tires. He cautioned against the use of too thin a carcass, and said that he doubts the need of a tire with a section as large as seven inches. A better compromise than that suggested by Hale may be possible. Nominal sizes are apt to follow along lines similar to those used with high pressure tires.

Thatcher, discussing certain points more fully, said that any pneumatic tire is a compromise between certain desirable qualities. He agreed with Hale in respect to the good cushioning quality of low pressure pneumatics, but

said they are harder to steer under some conditions and are more easily punctured. When the wheel is turned about the knuckle pivot the tire deflects and tends to snap the steering wheel back to its original position. This may cause trouble in the case of drivers not used to this tire.

Thatcher said that he is frankly fearful concerning the possibilities of accident with low pressure tires at high speeds, but added that this tire undoubtedly has a place in the industry and can be used to good advantage if its use is not carried to extremes.

W. H. Allen, of the B. F. Goodrich Co., said that there is no doubt as to the good cushioning qualities of low pressure pneumatics. There are, however, some big problems for the automotive engineer to solve and great need for cooperation between car and tire designers.

In closing the discussion, Hale stated that he stands squarely behind the statements made in his paper. They are, he said, the result of an extensive investigation. If later experiments indicate that he has been mistaken, in some respects he will be quite willing to alter his views. He pointed out, however, that the tire industry must not overlook the advantages of the new tire and has already moved very rapidly in its development.

Hale's paper was in part as follows:

THERE are good reasons for believing that the automobile industry is on the threshold of the third great development in pneumatic tire construction. In this move we will take advantage of the cord construction which has



James E. Hale, Firestone Tire & Rubber Co., brought some balloon tires with him

proved its durability and reliability, combine this with a much larger section and thinner wall and make it possible to ride on low pressure air for the protection of the car and greater comfort of the passengers, and this without sacrificing in economy.

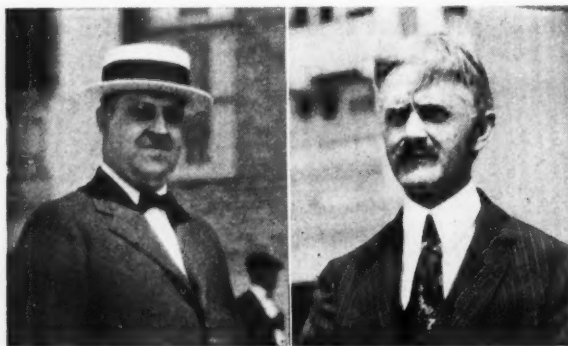
If we are to have greater cushioning for comfort and protection against vibrations of the car, the combination of low air pressure and large area of contact must be provided and by employing such tire constructions that the durability may not be impaired. The goal aimed at was to increase the area of contact sufficiently so that air pressures ranging from 20 to 35 lb. could be employed in actual practice.

Bursting Stresses Lower

One of the fundamental conditions of conservative tire use which we recognize is the limitation of the actual vertical deflection of the tire expressed in a percentage relation to the sectional diameter. It has been found that if this percentage of deflection is exceeded, the tires are likely to fail prematurely from two causes: First, tread separation and ply separation are likely to be excessive; second, the flexing localizes half way up the side-wall and may cause fabric failure on the inside plies. It can be readily appreciated that in the casing of a thick walled tire, the destructive effect of this flexing will be much more pronounced than in the case of a thin walled tire. But if we use low pressure air, the bursting stresses on the carcass are low enough so that only a few plies are necessary, and this in turn makes it possible to increase the deflection percentage.

Our tentative air cushion tire schedule offers 4 section sizes for passenger car use, each size to be made of no more than 6 plies, so constructed as to permit their normal use with pressures between 20 and 35 lb., and to be used on rims whose width is approximately 45 per cent of the tire section.

I find it almost impossible to choose descriptive phraseology to drive home the wonderful effect that these tires have on the riding of a car. The first reaction to the occupants is the greater degree of comfort. Road surface irregularities are toned down and in most cases are



Paul H. Geyser

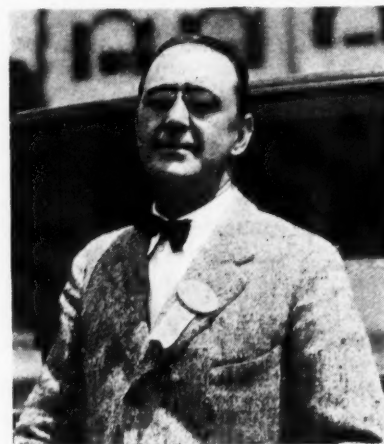
E. C. Newcomb

obliterated. Everything is cushioned so that there are no sharp shocks or jolts, and one does not have to watch the road to put his body in a tense condition to get over the rough places, nor be worried about being tossed up from the seat, and furthermore the driver does not have to pick out all the good places in a rough road, because it makes little or no difference whether he takes them in or not.

Of extreme convenience is the fact that in suburban driving where it is necessary to go off the pavement, one does not have to take any special precaution to slacken the speed, because the average road can usually be taken at the same speed as the pavement. Another important factor is that on rough roads, particularly in the country,

the air cushion tires smooth out the road so that a substantially higher average speed is practical.

Of equal importance to improving the degree of comfort is the effect on the mechanism and body of the car itself. So far no way has presented itself of making deliberate comparisons of the effect of low pressure air in preserving the car from developing rattles, creaks and mechanical depreciation, but there is no question about its being a tremendous factor, and all because of the fact that everything is cushioned. Compared with high pressure

O. J. Rohde, Vice-president Wire
Wheel Corp.

pneumatics, the sharpness of the shocks is very effectively softened.

Manifestly a thin wall tire having very low air pressure and large cross section with a big area of contact will roll over and envelop any projections with much less tendency to elevate the axle than will the tire with a thick carcass with half the area of contact and high air pressure.

In the case of dropping into a chuck hole, the air cushion tires, having a much greater permissible actual deflection in falling through the distances, are more gradually brought to rest, in fact so gradually that the effect is more of a rolling action.

Six taxicabs running a total of 20,000 miles during the month of April on 7.30 in. air cushion tires averaged 13.5 miles per gallon. This compared with 12.6 miles per gallon for a larger number of similar cabs covering many times that mileage on 33 x 4½ in. 6-ply tires with 70 lb. of air.

With air cushion tires, cars coast just as freely and accelerate practically the same as with high pressure pneumatic tires.

Little Effect on Steering

From laboratory tests we have found the area of contact of the air cushion tires with the road surface to be about twice that of the high pressure pneumatics, and under these conditions one can detect a slight difference in turning the wheel. In ordinary driving, this effect is of such minor consequence that it cannot be considered a serious handicap. We do find, however, that when the car is in close quarters parked by a curb, it is somewhat more difficult to pull the wheels around when the car has little or no headway. In some cases the larger tires actually favor the steering. For instance, on streets with trolley lines, the front wheels are not deflected at all in making a cross-over from one side of the street to the other, even though the angle at which the car makes the crossing over the rails be the next thing to parallel driving. Another favorable feature is when dropping into chuck holes or off the edge of the pavement, the reaction tending to deflect the

car is much less pronounced. In fact, in the latter case the control is infinitely better in regaining the pavement.

Just how far we should go in assigning the cause of front wheel shimmy to the application of the large section low pressure tires is not clear. I have personally encountered some cases of front wheel shimmy on both high pressure and low pressure pneumatics, and in each case the trouble has been taken care of by such methods of adjustment and replacing of parts as the ordinary repair shop has at its command.

Excellent Non-Skid Effect

On wet pavements (with the brakes properly equalized) I have tried every way that I could think of to make my car skid, but so far the only thing which happens is that the car stops. In the most ticklish traffic, I have no fear about what I can do in an emergency. The large area of contact combined with the greatly increased lineal total of non-skid edges which gives a squeegee effect is undoubtedly the combination which gives such excellent non-skid results.

On snow and ice the control of the car with air cushion tires is noticeably better than with high pressure pneumatics. This is particularly true in eliminating the tendency to skid sidewise in applying the brakes and making corners.

Since front wheel brakes are being so seriously considered by designers, I think they will do well to thoroughly investigate the capacity of air cushion tires to control the car. From this point of view it may be this new type of tire offers sufficient improvement in braking control so that front wheel brakes may not be necessary.

The question of danger from a flat tire has come up. If one were driving at 40 or 45 miles an hour and had a blowout on the right front what would happen? We are not in a position to make any very positive assertions on this point, as only two blowouts have occurred in all our testing experience. These occurred on a Lincoln test car when the car was going about 30 m.p.h. and the test car driver states that it did not in any way cause him to lose control of the car or display any tendency to become unmanageable. We tried the experiment of producing a flat tire on the right front wheel of a test car with 7.30 air cushion tires. Starting inflated, but with the inner tube valve insides backed out to rapidly deflate the tire, we ran along at between 35 to 40 miles per hour for a considerable distance after the tire was entirely deflated. We found it was necessary for the observer to step out on the running board to actually look at the tire to be sure that it had become fully deflated, and the driver found that he could take his hands off the steering wheel with no tendency to give trouble.

I presume that a little more side-sway can be detected and measured with the air cushion tires than with the high pressure pneumatics, but it is my observation that after becoming accustomed to the car, all thought about this feature disappears from the mind.

Disadvantages of Large Section Tires

Centrifugal force deforms the cross section of the tire, changing it from a substantially circular to an elliptical shape. The standing diameter is increased and the section diameter diminished.

Will the powerplant and transmission system stand this higher average speed without suffering? It is my opinion that the increased speed will amount to somewhere between 10 and 30 per cent.

For some reason which is not very clear to me, cars equipped with air cushion tires develop a violent galloping when they are not equipped with snubbers or shock absorbers.

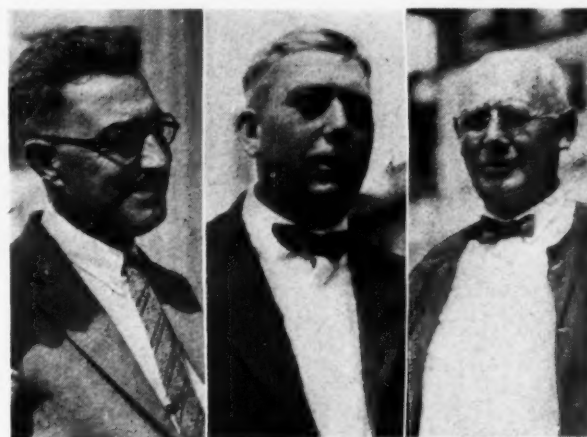
At the present time it appears that the amount of gather or toe-in on the front wheels will have to be very nicely adjusted to prevent the excessive wear which appears with improper alignment. Our observations point clearly to the fact that air cushion tires are more sensitive to improper alignment than the high pressure pneumatics.

There are two features of car operation which register against air cushion tires, namely mud splashing and dust raising propensities. The larger section tires with the greater area of contact spatter mud much more than any other tires heretofore brought out, and for dust raising on country roads, I can simply say that it is terrible.

To date we have a total of 850,000 tire miles under test observations, and evidence points to average mileage at least as high as those enjoyed with regular pneumatic tires. The character of the failures will unquestionably be somewhat different. For instance, ply separation and tread separation will be minimized in air cushion tires, and with these eliminated, the most prominent troubles will be fabric breaks in the carcass; also punctures and rapid tread wear on the front wheels when they are not aligned properly. Many people have questioned whether or not with such a thin tire, punctures will not be sufficiently numerous to be of considerable annoyance. There are no grounds for concern on this score. In 50,000 car miles of operation on our test fleet, there were 7 punctures, and in 100,000 miles of operation in taxicab service there was an average of 1 puncture for each 3700 cab miles.

No Tread Cuts with Air Cushion Tires

The explanation is found in the fact that the tire, being not so taut and hard and drum-like, yields rather than be pierced by the puncturing object. There is no doubt but that this lessened intensity of pressure is responsible for the almost complete absence of tread and ply separation. Air cushion tires run their life with no tread cuts whatever. The same applies to the side-wall; that is, in running in ruts or against curbs, or loose rocks in the road,



Frank Nutt Frank H. Martin J. D. Eccleston

an ordinary pneumatic tire is apt to have the side-wall scraped or abraded. With air cushion tires, however, the tire yields to the blow, thereby protecting itself and escaping injury.

With long life and protection of the car against destructive vibration effects and favorable fuel consumption, I believe the cost of car operation will be lower. The manufacturing details will be sufficiently different from those of regular pneumatic tires to have a slight influence tending to increase the tire cost.

The amount of cotton and rubber used in air cushion tires need not be much if any greater than that in the tires which they replace. Therefore, if we increase the

Some Outstanding Members of the S. A. E. Eske



JOHN WARREN WATSON
REPOSES IN THE LOBBY
WHILE WAITING FOR
THE DANCING TO
BEGIN.



CHAS. M. MANLEY SAYS SOME
SERIOUS WORDS ABOUT THE
WORK OF THE STANDARDS
COMMITTEE.



B. B. BACHMAN RAN THE
HEADLAMP GLARE SESSION
AMONG OTHER THINGS.



A. LUDLOW CLAYDEN
REGISTERS INTEREST
AT A TECHNICAL SESSION.



COKER F. CLARKSON STUCK TO
THE TENNIS COURTS REGARDLESS
OF THE WEATHER.

T. H. LITTLE, JR. PRESIDES
AT THE BALLOON TIRE
SESSION.



DR. H. C. DICKINSON AND
PROF. G. B. UPTON OF
CORNELL UNIVERSITY
WERE CAUGHT DE-
TONATING.

ROCHE
SPRING LAKE, N.J.

Esketched at Spring Lake

By Leo Roche

A. K. BRUMBAUGH BECOMES
DIGNIFIED AFTER BEING CHOSEN
AS ONE OF THE NEW COUNCILORS.HENRY L. HORNING ENJOYS OLIVES AS HE
DISCUSSES GREEK PHILOSOPHY AT THE
DINNER TABLE.HENRY M. CRANE
IN A MOMENT OF
RELAXATION.H. M. SWETLAND WEARING
HIS GENIAL SMILE.G. W. DUNHAM HAS THE
TYPE OF PROFILE
WE PEN & INKERS
LIKE TO SKETCH.JOHN R. CAUTLEY TAKES IT EASY WHILE
WAITING FOR THE DINING ROOM TO OPEN.IN SPITE OF THE HOT WEATHER M. C. HORINE
ATTENDED THE EVENING MEETINGS AND
LOOKED MIGHTY COMFORTABLE.L. CLAYTON HILL
WON THE PLUNGE
FOR DISTANCE
IN HIS SPARE
TIME.THACHER WATCHES THE FIELD SPORTS FROM
A COOL SPOT ON THE VERANDA.

section, we can make a corresponding decrease in the thickness of the walls of the tire.

The 4.40 air cushion tires of either 2 or 4 plies on a 3 in. S.S. rim is proposed for cars with approximately 100 in. wheel base now using $3\frac{1}{4}$ in. pneumatics. The 5.25 in 4 plies on a $3\frac{1}{2}$ in. rim is to substitute for 4 in. regular pneumatics on cars ranging from 109 to 115 in. wheel base. The 6.20 in 4 or 6 plies on a 4 in. rim is designed to serve in place of some of the 4 in. and most of the $4\frac{1}{2}$ in. on cars of 118 to 126 in. wheel base. The 7.30 air cushion tire in 4 or 6 plies on a $4\frac{1}{2}$ in. rim is offered to serve in place of a few $4\frac{1}{2}$ in. and all 5 in. tires as applied to cars of 130 in. wheel base and over.

Fender, body and brake drum clearance, also change in tread of the car in fitting air cushion tires, bring up a very complex situation. Suffice it to say that it must be accepted as a foregone conclusion that any change in tire equipment which results in the use of the larger sections and smaller rim clearance is very likely to bring about interferences and changed relations of parts which must be provided for.

It is to be sincerely hoped that the automobile industry will not requisition more than one standing diameter for each section. The tire manufacturers have always been dreaming of the time to come when they would not have to make a series of standing diameters for each section, and whatever the final disposition of this matter, I bespeak for the tire industry a real serious attempt to carry out some such program.

Careful Inflation Necessary

I propose that when we finally work into air cushion tires, the true section size be used as the name size. It does not strike me as necessary to give a standing diameter, since there will be only one standing diameter for each section.

It is my belief that in introducing the air cushion tire, the industry should start with the firm determination to make oversizing unnecessary and not even provide for it.

It is my judgment that air cushion tires should be very carefully inflated and should check to within 1 lb. of the correct pressure.

DISCUSSION consisted largely of questions and answers. A summary of Hale's replies is given below.

It is believed that liability of injury from cutting, as on glass, is no greater than with other types of tires.

If the tire is properly inflated it cannot roll over enough to bear on the side wall in rounding a curve at speed.

Road clearances are about the same as with other tires of the same outside diameter.

Effect of New Tire on Road Uncertain

Exact data concerning comparative cost are not as yet available but the difference is expected to be very slight as compared to the ordinary cord tire.

Side walls have been found to resist the effect of scraping against curbs better than high pressure pneumatics.

Exact comparative measurements of temperature rise in service have not been made but it is believed that the rise will not exceed that of high pressure pneumatics under similar conditions, and may be less because of the greater area and less body of the tire.

Tubes hold their pressure better than with high pressure pneumatics.

Experiments with grooved treads indicate that good results will be secured but tests with this type of tread have not yet progressed far enough to make certain conclusions possible.

Low pressure pneumatics are being tried on buses but definite information concerning their performance is not yet available.

Tests referred to in the paper on relative fuel economy of taxicabs using respectively high and low pressure pneumatics were made in parallel (at the same time) so that results are believed to be truly comparable.

Replying to a question as to whether the Firestone company is ready to offer low pressure pneumatics to the public, Hale said that development work has progressed far enough to turn the tires over to the sales department to be marketed.

Shock absorbers or snubbers are needed on cars fitted with low pressure pneumatics in order to damp out rebound. The effect of deep ruts on side wall chafing is believed to be about the same as with high pressure pneumatics, but there is less tendency to drive in ruts owing to better cushion qualities.

The effect of the new tire on the road is uncertain, as is also the effect on the tire of neglecting to keep it inflated to the proper pressure. In reference to the difficulty of turning the wheel in parking, it was pointed out that the tire can easily mount the curb without injury so that parking in crowded quarters is made easier from this standpoint.



G. W. Gilmer, Jr.

F. W. Gurney

B. B. Bachman

R. S. Burnett

Charles A. Manly

Four-Wheel Brake Is Fundamental Improvement, in Opinion of Engineers

Now up to designers and manufacturers to produce a good job. Some objections raised to immediate installation. Present day system considered inadequate. Keen interest manifested.

ULTIMATE general adoption of four-wheel brakes for larger cars was predicted almost unanimously at the four-wheel brake session. Opinion on this point was apparently well crystallized, although some objections were raised to immediate installation, based on the belief that details should be perfected before sales pressure demands production. The situation was defined by one speaker as another of the cases in which the American public is no longer tolerant of a compromise, the reaction resulting in developments which approximate the ideal. The high braking value of the four-wheel system was recognized by every speaker, but in each case the absolute necessity for equalization of braking moment rather than pressure was emphasized.

The desirability of more simplified installation, particularly in intermediate linkage and compensating devices, was given prominence. A brief opinion of the legal patent phases indicated that a broad field of design is open.

Keen Interest in Four-Wheel Brakes

Attendance at the session and interest shown were clear evidences of the predominating interest aroused by the four-wheel brake question. In spite of this morning meeting conflicting with golf and other hot weather activities the attendance was over 200. All phases of the industry were represented and all those in attendance were keenly interested from President Alden's opening remarks until the last question was answered.

Two illustrated papers were read, one by A. M. Yocom, describing the four-wheel mechanical braking system devised by the U. S. Axle Co., the other by M. Guillemont and describing the Renault servo-brake system. The Renault system was described fully in *AUTOMOTIVE INDUSTRIES* for June 21, while full details of the U. S. design appear in the leading article. In the absence of Malcolm Loughead and Fred Duesenberg, who were to have presented additional papers, the discussion was then turned over to several prominent engineers.

The decelerating advantages of the four-wheel system were pointed out by Charles L. Sheppy of Pierce-Arrow. Sheppy warned against installation of four-wheel brakes before axles, springs and steering linkages are built up to stand the stresses involved. Figures compiled from comparative tests were presented, demonstrating that a greatly increased portion of the car weight is transferred to the front axle during the rapid deceleration which results from the application of four-wheel brakes at high speeds. Sheppy also pointed out the possibility of locating the projected center lines of the steering knuckles inside of the tread gage of the wheels, stating that this arrangement is entirely feasible if the steering cross link is of sufficient section.

A somewhat adverse view was presented by Henry M.

Crane, who emphasized the ability of a properly designed transmission brake as opposed to the four-wheel system. He stated that in his opinion the simplicity of the present day installations, with the comparative safety of steering, was not offset by the improved braking ability of the four-wheel system in the hands of the average driver. Crane, however, advocated the necessity for an improved servo mechanism with the application of four-wheel brakes on heavy cars.

Direct issue with this opinion was taken by L. H. Pomeroy, who inferred that the retention of the present day braking system was analogous to the building of cars with engines of but a single cylinder. Pomeroy



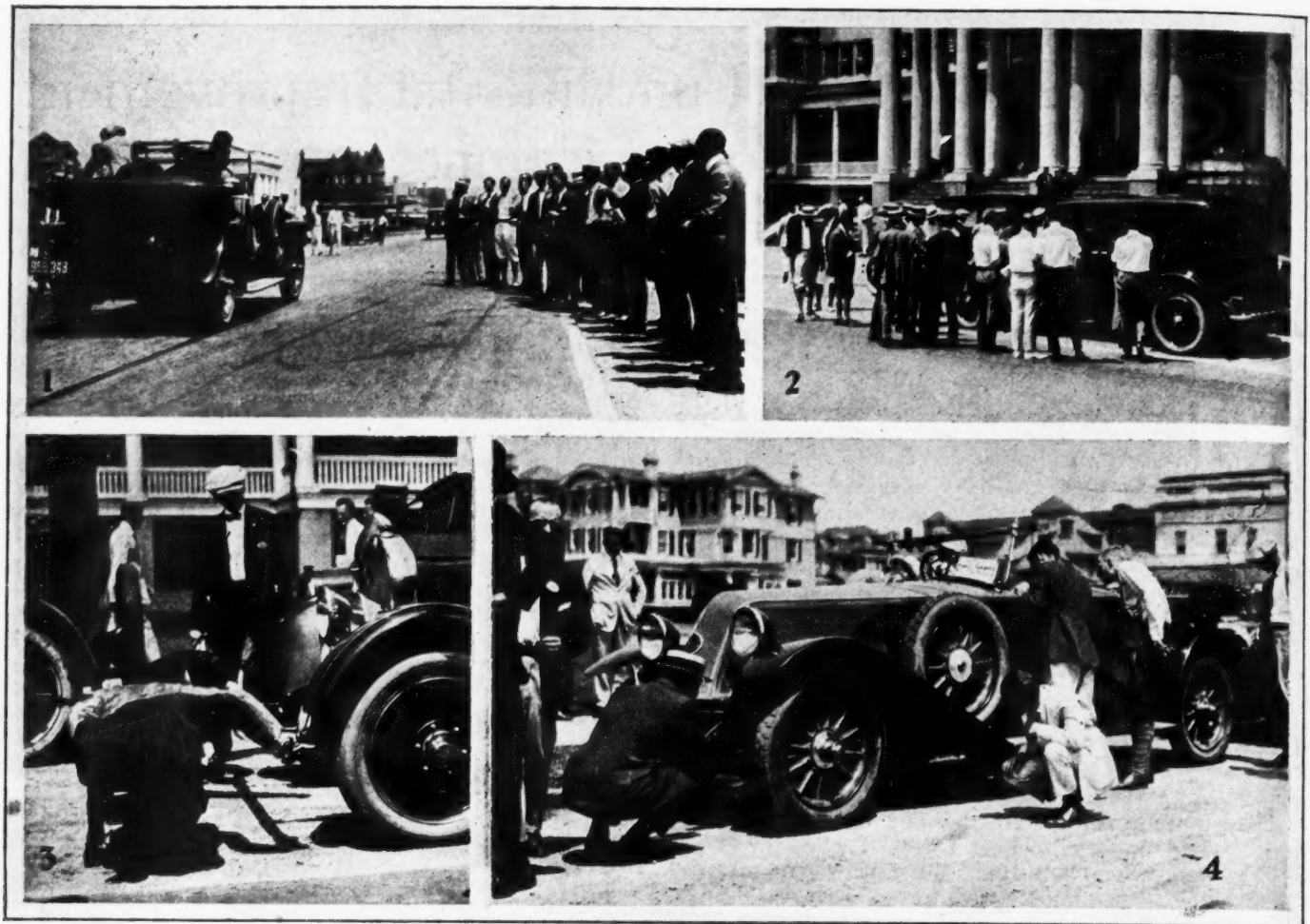
L. H. Pomeroy C. L. Sheppy M. Guillemont A. M. Yocom

advocated mechanical control of four-wheel brakes and drew upon his experience in citing a case for which he claimed excellent operation. He demonstrated the relatively small variation of braking moment resulting from variation of coefficient of brake lining as involved in the internal expanding shoe type as opposed to the contracting band type. He further stated that greater success could be obtained with the expanding shoe type if the diameter were decreased, but the same total weight retained largely by circumferential fins on the drum which were tied together at frequent intervals by transverse ribs.

Danger of Hasty Design Emphasized

Several engineers gave opinions which were substantially along similar lines, advocating the four-wheel braking system. In practically every case the improved handling of the car was emphasized and the disadvantages of the present rear wheel braking systems condemned. Reduced to brief terms, the opinion of these engineers, including T. J. Litle, Jr., W. G. Wall, Cornelius T. Myers and others crystallized in the expression, "The die is cast, the four-wheel braking system is here, it is a fundamental improvement and it is now up to the engineer and manufacturer to roll up their sleeves and design and produce a good job of it."

The possible disadvantages arising from poor equali-



Four-wheel Brake Demonstrations Arouse Interest

1—Making a quick stop. 2—The Isotta-Fraschini draws a crowd. 3—Some engineers take a close look at the Isotta braking mechanism. 4—Getting a close-up on the brakes of the new Renault

zation, fractional shoe contact or hasty design were emphasized in each talk. The system must be designed to render available improvements in service in the hands of the average driver who is not an expert at brake adjustment. The opinion of these men was practically unanimous in that the improved retarding ability of four brakes more than offsets the added complication of a good design.

Vast Opportunity for Original Designs

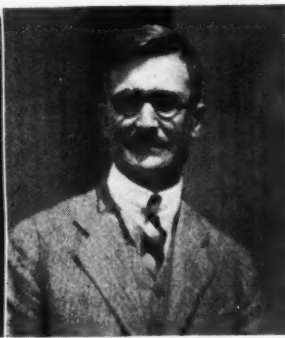
Outlining the possibilities for future development of original designs, R. A. Brannigan of the N. A. C. C., stated that although one hundred patents on four-wheel braking systems had been issued in this country, there is

still a vast opportunity available without probability of infringement.

In response to a request for the status of four-wheel brakes in France, M. Guillemon stated that easily 75 per cent of all cars of more than 10 hp. made in his country are being equipped with that braking system. The reconstruction of practically 4000 comparatively new Renault taxicabs for the installation of four-wheel brakes is anticipated. These cabs are in operation in Paris and the demand for the new system is momentarily expected. The attitude of the British market was quoted by Pomeroy as being midway between that of France and this country, with the same positive trend of demand toward the four-wheel system.



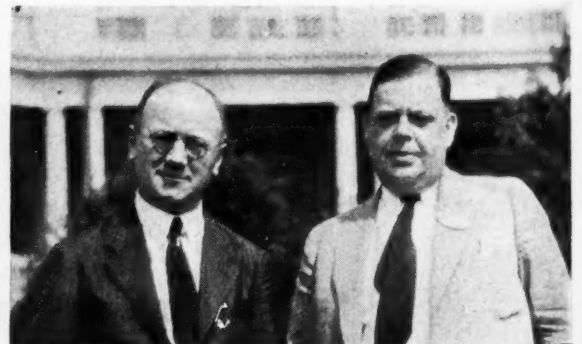
A. D. T. Libby



John G. Perrin



Wm. Foster



F. M. Germane and C. B. Wisenburgh

Turbulence as Factor Governing Spark Advance Eagerly Discussed Topic

Significance of phenomenon beginning to be realized. Research reveals fact that engine temperature has important bearing upon tendency for present fuels to dilute crankcase lubricants.

THE paper which elicited the most discussion at the fuel session was that by Prof. G. B. Upton, of Cornell University, on the subject of spark advance in relation to engine performance. In this paper Upton gave considerable prominence to the effect of turbulence in relation to spark advance and showed that turbulence is one of the chief factors in determining the amount of advance required. An abstract of the Upton paper is given below.

Of the other two papers presented, that by Stephen M. Lee, of the Bureau of Standards, dealt with the joint fuel research work done under the direction of the S. A. E. Research Committee and similar committees appointed by the American Petroleum Institute and the National Automobile Chamber of Commerce.

The tests in question included road runs made with two cars on the Washington Speedway, using two grades of fuel of different volatility. These tests were conducted under cold weather conditions but otherwise were similar to those described at the last annual meeting of the Society, run under warm weather conditions. In general, the results were not greatly different from those of the summer tests. Such differences as were noted are of small significance when the relative ability to produce the grades of fuel used is considered.

Other tests, calculated to learn definitely what factors, if any, make material differences in performance as between widely differing grades of fuel, have since been confined to work on engines in the laboratory, where variables which cannot be controlled on the road are under definite control. Some of the conclusions drawn from these experiments are summarized below.

A second report on an independent set of road tests made by various car manufacturers under conditions laid down by the S. A. E. Research Committee, was made by Dr. H. C. Dickinson, manager of the S. A. E. Research Department. These road tests are similar to others, made by approximately the same group of manufacturers, the results of which were reported upon at the last annual meeting of the Society in January. The tests reported at Spring Lake were run under winter conditions as compared to summer conditions which obtained in the earlier ones.

The fuels employed were similar to those used in the summer tests, but had a slightly different percentage of light fractions and somewhat lower initial boiling points.

Among the companies which cooperated were Autocar, Buick, Dodge, Ford, Hupmobile, Studebaker and Waukesha. Each concern ran groups of four cars for a period of one week on each of four fuels which were so designated

that their characteristics could not be discovered by the users.

The average mileage of the cars per gallon of fuel consumed varied from 12.4 for the less volatile fuels to 12.8 for the most volatile, or a difference of about 3 per cent in favor of the lighter fuels, a difference so small as to be of little significance, although the average temperature was about 40 deg. Fahr. as compared to about 70 deg. Fahr. for the summer tests.

In this instance each user was requested to give his opinion as to the relative suitability of the four fuels as judged by the service tests by arranging them in the order

of his choice. Eleven out of thirteen chose a fuel designated as "X," which contained the largest percentage of low boiling fractions, although it had a higher end point than some of the other fuels tested. There was substantial unanimity in designating the least satisfactory fuel which was a fuel of rather high 90 per cent and end points.

The tests showed also that use of the less volatile fuels resulted in a higher percentage of crankcase lubricant dilution, a result quite similar to that found in the similar tests run in warm weather. A number of the cars tested were the same ones used in the summer test or were of precisely the same model. The average miles per gallon was about 18 per cent greater under summer conditions.

So far as relative fuel consumption is concerned, it is concluded that the slight difference in mileage as between the most volatile and the least volatile fuels tested is not of sufficient significance to offset the much greater production from the crude which is understood to be possible when this production is confined to fuels of higher average boiling point.

Following is an abstract of Upton's paper:

THE Upton paper shows that proper timing of the spark is as essential as having a spark. Experimentally, an error in timing of ± 20 deg. in a low compression engine, or ± 15 deg. on most engines, causes a loss of 10 per cent from the best power and economy, other things remaining the same. Hand control, or semi-automatic, can hardly average closer than ± 15 deg. to the correct advance, as speed and load combinations are constantly changing on the road.

The problem of spark advance has two phases of importance. The first is to find whether the requirements of optimum spark advance, at various combinations of load and speed, are such as might be met by simple automatic apparatus. To this practical question the answer



Prof. G. B. Upton

is apparently yes; optimum spark advance can be satisfactorily represented by additive functions, one of speed only, and one of load, or intake suction only. Hand adjustment would still be needed to take care of the difference between a clean engine and a dirty one, or to take care of a cold engine; but once an engine was warmed up the automatic controls could take care of maintaining proper spark advance, increasing in practice the power, flexibility, and economy of the engine.

The second phase of the spark advance problem is that of scientific analysis. Spark advance is necessary because combustion takes time, and the piston is moving while combustion proceeds. Proper spark advance maintains a



R. E. Wilson Thomas Midgley, Jr. S. M. Lee

definite relation between the progress of explosion and the motion of the piston. It is shown in this paper that the relation should be such that half the rise of pressure during combustion coincides with the dead center position of the piston; and analysis, theoretical and experimental, shows also that half of pressure rise occurs substantially at $\frac{3}{4}$ of the explosion time from ignition to pressure peak. This is then the numerical basis for the relation between explosion time, engine speed, and optimum advance of the spark.

A review is given in the complete paper of extant data on explosion time as affected by mixture ratio, size of combustion chamber, turbulence, dilution with burned gases, and temperature preceding explosion. Density is shown not to affect explosion time. The factor often supposed to be density, demanding increase of spark advance as the engine is throttled, is really dilution with exhaust gas, the percentage of dilution increasing as the throttle closes. The factor supposed to be density, causing faster explosion in a high compression engine than in a low compression engine, is in reality temperature preceding ignition.

Factors Affecting Explosion Time Named

From bomb experiments with turbulence a simple mathematical law connecting explosion rate and turbulence is derived. The same law is shown to be applicable to engines, and the manner of working out the turbulence factor for any engine is shown. This opens the way to quantitative experiments on turbulence in various designs of engine, and hence to development of designs of highest turbulence, if such development seems desirable. It is the turbulence factor which makes really high rotative speed compatible with good power output. Yet it should be mentioned that an equally important factor in making explosions in engines quicker than in bombs is the heating during the compression stroke (adiabatic compression).

The slowing up of combustion due to dilution of charge with exhaust gas was measured experimentally, and results are shown, and compared with the numerical extent of the dilution.

The scientifically valuable part of this paper is in the naming of the factors affecting explosion time in the engine; giving mathematical expressions for their laws of action; and finding numerical values of constants for such factors as turbulence and dilution. The measurement of optimum spark advance is made available as a research method of investigation of reaction rates of combustion, and hence of all that related group of topics now of such interest to automotive engineers.

Measurement of Optimum Spark Advance

As an example of this application of measurement of optimum spark advance the combustion rates of gasoline with and without antiknock (tetra-ethyl-lead) were measured in the engine. Though the dosage used was 20 times normal, no change in reaction rate of combustion was found where combustion remained normal, without detonation. In the region where detonation occurred, without antiknock, the reaction times with antiknock followed the expectation of normal combustion; the detonation apparently changes the combustion habit as if it made an abnormal top to the combustion.

IN opening the discussion in the fuel session Chairman Crane pointed out that the tests now being undertaken have been greatly widened in scope and are calculated to learn fundamentals rather than to secure such general information as is possible when only road tests are made. He requested that members of the Society make whatever suggestions they consider desirable for the benefit of the Research Committee and said that they should feel free to ask questions concerning the work undertaken.

In commenting upon Dickinson's report Crane said it is worthy of note that the users of the four fuels thought that those containing a considerable proportion of light fractions were the most satisfactory even though they have a high end point and are not the best ones for the engine.

Concerning the Upton paper, Crane said that it is obviously desirable to have means for insuring the best possible spark setting but it is difficult to see how such means can be provided without considerable complication.

Thomas Midgley, Jr., said that with a large excess of tetra-ethyl-lead in the fuel the power is sometimes slightly decreased. The antiknock is most effective, however, under full load conditions when the tendency to detonation is greatest.

O. E. Berry stated that it had proved possible in tests which he had conducted to secure about three more m.p.g. when the spark is properly adjusted than are secured when the spark is set, as it usually is, to give a maximum rate of acceleration. He described a spark advance arrangement employing a Sylphon tube to give the necessary control under influence of manifold depression, but stated that the patent situation in this field is complicated and recommended that those who contemplate the use of an automatic spark advance mechanism look up patents bearing thereon before proceeding.

S. W. Sparrow called attention to the slow initial rate of combustion which immediately follows ignition and stated that this often has a marked effect upon spark advance. The position of the sparkplug also has a great deal to do with the amount of advance required.

R. E. Wilson asked whether the effect attributed to dilution with burned products mentioned by Upton is not really a pressure effect. To this Upton replied that the time of combustion is entirely independent of pressure over a very wide range of pressure values.

Chairman Crane stated that in one engine of the overhead valve type which he designed it had proved necessary

to use a 60 deg. spark advance to secure maximum power when only one sparkplug was employed, whereas when two plugs were used only 35 deg. was required although the maximum power was approximately the same in both cases. Upton stated that this agreed substantially with the conclusions reached in his paper.

Herbert Chase called attention to the fact that the flame which issues from the exhaust port of an engine running under high load conditions seems to indicate that combustion is not complete at or near top center as Upton stated, but continues up to and after the exhaust valve is open. To this Upton replied that after-burning often takes place, especially with rich mixtures, but that observation through a window in the wall of the combustion chamber has shown that combustion is complete at or near top center under usual conditions of operation.

In discussing the report which Lee presented, R. W. A. Brewer stated that an analysis of the exhaust gases might well be included in the report, since it is not clear to what extent the results are affected by incomplete combustion. He said also that the characteristic curve of the carbureter employed on the Ford engine, which is a model L-4 Kingston, should be included. Crane agreed that both these suggestions are in order and that data concerning them will probably be included later, although S. W. James said that he considers exhaust gas analyses of doubtful value on account of the fact that these gases contain unburned products resulting from the partial combustion of lubricating oil.

H. L. Horning stated that after-burning is an important factor in controlling the temperature of the exhaust of an engine, and said that experiments which he has made have shown that the exhaust temperature can be very materially decreased by increasing the degree of turbulence in the combustion chamber. One of the effects of turbulence is to help burn layers of gas adjacent to the cylinder walls, which layers tend to remain unburned unless turbulence exists. Horning said further that it is difficult to secure good turbulence with the usual forms of combustion chamber employed with overhead valve engines. The spark advance required is largely dependent upon turbulence while thermal efficiency is greatly affected by the same phenomena. Thus the spark advance becomes in a way a measure of the degree of turbulence as Upton pointed out. The location of the sparkplug is also of great importance. Horning indicated it should be as near as possible to the center of gravity of the charge to be burned. In one case mentioned by Horning a change in the form of the combustion chamber which materially increased turbulence made it possible to decrease the spark advance for maximum power from 37 to 4 deg.

Changes in Viscosity Affect Economy

Horning emphasized also the effect of changes in fuel viscosity on economy and confirmed parts of the report which Lee presented by stating that this effect may be greater than that caused by differences in volatility. The carbureter fuel orifice should be designed, said Horning, to minimize the effect of changes in fuel viscosity. He added that he had found that the degree of spark advance required is dependent to some extent upon the proportion of burned products remaining in the cylinder.

Crane cautioned against the use of what he termed "trick" sparkplugs, in which the electrodes are shielded in such a way as not to come into intimate contact with the charge to be burned. Great differences in power and performance are apt to result if this factor is not given consideration.

The conclusions drawn from Lee's report on the summer road tests on the Washington Speedway Course are as follows:

UNDER summer weather conditions the differences in economy obtainable with the four test fuels were much smaller than the differences in estimated production of these test fuels.

The results were sensitive to small changes in carbureter adjustment as illustrated by the fact that with a fixed adjustment better economy was obtained with the less volatile fuels, whereas when the carbureters were adjusted for each fuel somewhat better economy was obtained with the more volatile fuels.

More Dilution with Less Volatile Fuels

The results of the road tests for crankcase dilution indicate that there was a greater rate of dilution with the less volatile fuels.

At constant speed and with very lean carbureter settings the fuel consumption with "B" fuel was less than with "D," but at carbureter settings for normal use, the reverse is true.

This is due to the fact that a leaner mixture is obtained with "D" than with "B" at a given carbureter setting because of its greater viscosity. This is also the explanation of the differences in fuel consumption at fixed carbureter settings, found in the summer runs.

The results of the winter road tests are then in general agreement with those of the summer tests. For this reason and because of the impracticability of making a study of the relative effects of the various operating conditions when all conditions are varying widely, it was decided to concentrate time and effort upon the engine set-up in the laboratory.

Many trial runs were made with the four test fuels under conditions covering a wide range of air temperature, circulating water temperature, mixture ratio, speed, and load.

With each speed, load, air temperature, and fuel a mixture ratio run was made, i.e., the carbureter was adjusted



C. T. Myers

O. A. Parker

Webb Jay

for what appeared to be a maximum power mixture and the fuel consumption taken with that setting. Then two leaner and two richer settings were also used.

There was usually no difference in fuel consumption as between the test fuels "B" and "D" at either maximum power or maximum economy carbureter settings.

With this (the Ford) engine under conditions of low speed and temperature, more of "D" than of "B" is required to give a maximum power mixture or to operate at all.

The results indicate a decrease in fuel consumption with rise in temperature and this effect is perhaps more marked in the case of "D" fuel. The temperature effect is most pronounced at that speed and load at which the difference between "B" and "D" appeared.

The reasons for this change in consumption with temperature are probably also the reasons for differences in economy as between two fuels of widely different volatilities. If all cylinders of an engine could be fitted with



A. T. Brown, president Brown-Lipe-Gear Co.

J. D. Mooney, president General Motors Export Co.

H. T. Ewald, president Campbell-Ewald Co.

identically equal mixtures of gasoline vapor and air at the time of ignition regardless of air temperature and the volatility of the fuel, there is little reason to believe that there would be an appreciable difference in fuel economy between fuels or temperatures within ranges considered.

However, at the temperatures and with the fuels used in this test the mixtures received by the cylinders may not be similar and the fuel may not always be entirely vaporized by the time of ignition.

The results of the constant speed tests with the "Z" engine do not show large differences in fuel consumption as between fuels "B" and "D." The greatest difference observed was much less than the difference between the estimated productions of the two fuels.

It is concluded that the difference in volatility which exists between "B" and "D" fuels is not so large as to produce considerable differences in fuel consumption in existing automobiles, at least under constant speed conditions. Whether or not richer mixtures would have to be used with the less volatile fuel in order to obtain equal ease of starting and acceleration is yet to be determined. It should be remembered in this connection that the accelerations involved in the Speedway tests were satisfactorily accomplished with the less volatile fuels.

Results of Needle Valve Tests

The reasons other than difference in efficiency why the (carbureter) needle valve opening must be increased to give a maximum power mixture when the air temperature is decreased, seem to be as follows:

(1) The lower the air temperature the less the pressure difference inducing fuel flow which will be produced by a given weight of air flowing through the carbureter. The air flow remaining unchanged and the fuel flow decreasing, a leaner air-fuel ratio will result if the needle valve opening is not increased.

(2) The lower the fuel temperature the greater its viscosity and the greater the viscosity the less the flow, other conditions remaining the same. To maintain a constant air-fuel ratio this effect must also be compensated for by an increase in needle valve opening. The increase in fuel density with decrease in temperature tends to compensate for this viscosity effect but with gasoline the viscosity changes much more rapidly with temperatures than does the density.

When drivers observe a difference in fuels as regards flexibility, power, and acceleration, these differences may be due more to the fact that a leaner mixture is obtained with the less volatile and more viscous fuel at a given carbureter setting than to any difference in vaporization or distribution. In fact the fuel consumption may be as low or lower under these conditions.

*This is understood to be a Ford engine.

Variations in the end points of the gasoline now sold may indicate corresponding variations in viscosity.

Some preliminary runs made at 600 r.p.m., full throttle and part throttle, with "A" and "D" fuels and with several mixture ratios indicated as follows:

(1) That the rate of dilution with the less volatile fuel "D" was greater than with "A."

(2) That the dilution was greater at full load than at part (with the same air and water temperatures), and

(3) That the richer the mixture the greater the dilution.

A greater rate of dilution was obtained with the less volatile fuel "D" than with "B" under each of four combinations of air and water temperature. This difference in rate of dilution is evidenced not only by the viscosity and per cent dilution curves but also by the change in the amount of lubricant in the crankcase. The apparent oil consumption is almost always less with "D," indicating a greater addition of fuel to the lubricant.

It is evident that with this engine and within the given ranges of temperature the circulating water temperature had a much greater influence upon the rate of dilution than did the carbureter air temperature.

The rate of crankcase dilution was greater with the less volatile fuels under all conditions of test. In that these conditions cover a wide variation of load and mixture ratios and of air and water temperatures it is reasonable to suppose that such would be the case during a large majority of the time of operation of existing cars. That many cars use engines differing from the test engine in design may alter the magnitude of the difference but not its existence.

In general it has been found that the circulating water temperature has the greatest single influence upon the rate of dilution and that mixture ratio has considerable effect.

Engineers Trying to Design Cargo Carrying Vehicle for Use of Army

Efforts were made to devise specifications for a single type of cargo-carrying vehicle for all forms of army war service at the meeting of the Ordnance Advisory Committee Wednesday. While this objective was not reached, it seems probable that as a result of the discussion the ten or twelve types now in use can be reduced to two: one a 2½-ton and one a 5-ton model. Probably both will be tractor caissons.

Obvious difficulties stand in the way of designing a vehicle equally suited to the varying cargo-carrying needs of the infantry, heavy artillery, light artillery, medical division, cavalry and tank corps. The Government is eager to develop such a vehicle, however, and to this end that the efforts of the conference were directed.

The difficulty of getting into production rapidly on a special vehicle in time of war was one of the chief practical objections brought out at the session. After considerable discussion it was rather generally agreed that one of the 2½-ton caterpillar tractors now being made commercially will meet all requirements except those of the tank corps. For tank corps service, a 5-ton, specially designed job appears to be necessary.

Definite conclusions were not reached by the committee, as ultimate decision rests with the army. The Ordnance Advisory Committee consists of two sections, one of army members and one of S. A. E. members. The committee is as follows:

Army: General C. L. H. Ruggles, chairman, General S. D. Rockinbach, Col. George Vidmer, Col. C. F. Jenks, Col. C. S. Stayer, Major A. B. Quinton, Major B. O. Lewis, Major W. R. Scott and Major J. W. Anderson.
S. A. E.: Col. William G. Wall, Col. H. W. Alden, George W. Dunham, Charles M. Manly and B. B. Bachman.

Drastic Legislation Predicted Unless Headlamp Standards Are Utilized

Representatives unanimous in this belief. Favor supporting existing measures. Manufacturers urged to take lead and not leave adjustments to dealers. Specifications up to engineer.

MORE drastic headlamp legislation is inevitable unless motor vehicle engineers, manufacturers and dealers avail themselves of the simple, inexpensive standards which have already been set up. This warning was the outstanding feature of the meeting devoted to headlamp glare. These standards are the product of the joint effort of the Society of Automotive Engineers, the Illuminating Association Committee, the U. S. Bureau of Standards and the motor traffic administrations of a great number of the states. Representatives of these organizations were present at the meeting and were unanimous in predicting more stringent legislation unless headlamp construction, equipment and road adjustment is given



R. N. Falge, of Nela Laboratories, read a paper on headlamp glare

attention and made comparable to the engineering standards of the balance of the car.

A common ground which is convenient for every interest involved is within reach of the manufacturer. In fact, the necessary features of design embracing location, lens and reflector equipment and focus adjustment are included as original equipment by the majority of manufacturers. These features are, however, of small value if adjustment is left to the average present day dealer. He derives no immediate income from the adjustment of headlamps and, therefore, hands improper, illegal lighting equipment onto the customer, who has not the slightest idea of what internal conditions are necessary for compliance with the law and the public safety.

Education of the dealer and, through him, of the customers, was emphasized in almost the same measure as the thread of drastic legislation. If a manufacturer has tested lamp equipment to his approval and the satisfaction of the joint code, it is but logical for him to insure the same standard of performance in the hands of the ultimate user. It was also pointed out that specification is the function of the engineer rather than the purchasing agent. Too many lenses, bulbs and reflectors of a slightly smaller original cost, but a tremendous decrease in efficiency have been substituted by the purchasing agent after adequate specifications by the engineer.

In an illustrated paper, R. N. Falge of the National Lamp Works of the General Electric Co., presented the existing situation and its remedy before a well attended meeting. A demonstration followed, in which the bad effects of maladjustment of focus or lamp location, poorly ground lenses and imperfect reflectors were graphically shown. As opposed to these objectionable features, the results of well designed, existing lamp installations were also pointed out. In every case the standard lighting diagram was used.

In his paper, Falge stated in part:

DESPITE the progress that has been made in the last few years in improving automobile headlamps, the conditions prevalent on the main highways of the country, particularly those near large cities, remain unsatisfactory. The genuine concern that is apparent everywhere, the fact that State legislatures in attempting to improve conditions are finding it necessary to strengthen the laws all indicate that this matter, which has so direct a bearing on the safety of the motorist, has not been handled as effectively as have others of less importance that have to do merely with road performance and repair bills.

Without question, if motorists generally could be made to realize two facts, an immediate and far-reaching improvement in head-lamps would result. These are that

- (1) It is entirely possible to get better road illumination, and at the same time prevent objectionable glare, by properly adjusting the majority of the head-lamps now in service
- (2) A driver, who makes the proper adjustments now, without waiting for others to make them, not only will remove the annoyance he is causing everyone else, but also will provide himself with a head-lamp that is better and safer and that will make it easier for him to pass cars with glaring head-lamps.

The erroneous idea that headlamp adjustments are made for the sole benefit of others would more easily be dispelled and the cooperation of motorists in improving conditions would be obtained more readily, if motorists were provided with accurate equipment, simply adjust-



H. C. Abell R. E. Carlson G. R. Pennington Marie Luhring



A. C. Bergmann

I. C. Freeman

E. L. Jones



W. M. Sweet



F. E. Watts



M. L. Heminway

able, and with instructions so clear and so comprehensive that they might easily be followed and intelligent allowance be made for such commercial variations in the equipment as would affect the distribution of light.

Good head-lamps without objectionable glare may be obtained by concentrating the rays emitted in all directions from the filament of the lamp into a shallow band of light having a candlepower hundreds of times greater than that of the lamp, directing this band of light straight ahead of the car and tilting it so that the top edge or cut-off of the beam is at the level of the head-lamp. The beam should spread to the sides far enough to illuminate the ditches and turns. A diffused light of low intensity sufficiently strong to reveal pedestrians, overhanging obstructions and the like, but not enough to blind approaching drivers, is desirable above the cut-off.

To illuminate the road-bed most effectively, the maximum intensity should be placed as near the top of the beam as possible, whence it will be projected farthest down the road. Since the eye accommodates itself rather slowly to changes of intensity, the candlepower should fall off toward the bottom and sides of the beam to illuminate the road-bed evenly and to eliminate the bright spots that reduce the visibility of points beyond them.

Lamps should be uniform and efficient in performance throughout their life. They should have highly concentrated filaments to give the minimum beam-divergence. The filaments should be placed accurately with respect to the locking pins and to the axis of the base to minimize beam distortion. They should not sag in service.

Sockets should grip the bases firmly and fit the reflector sleeves closely so that the lamps shall not be jarred out of adjustment when the car passes over rough spots in the road. The socket and the reflector axes should coincide. The electrical resistances at the contacts should be low to minimize the loss of light.

Reflectors should be highly efficient and should not warp or tarnish in service. Inaccurate contour causes glare and unsatisfactory road illumination.

Lenses should be free from hills and hollows caused by the careless polishing of the glass molds. Their design should be based on sound engineering principles.

Door should be easy to remove and to replace. Means should be provided to prevent the lens from rotating.

Universal mountings should be provided to facilitate aiming. The importance of proper aiming cannot be over-emphasized.

Adjustments should be carefully made before the car is delivered to the owner and simple but adequate instructions for readjusting should be given in the instruction book.

The fact that a few of the parts manufacturers are able to furnish equipment that will meet most of the requirements discussed above at little if any increase in price is proof that it is today commercially possible and practicable to attain the required standards of accuracy. Satisfactory performance, however, is unquestionably of sufficient importance to justify the small additional cost



Neil McMillan Jr.



R. A. Brannigan



J. I. Brandenburg

of thoroughly satisfactory equipment when it is necessary.

The use of devices that will obviate the necessity for focusing and that will leave to the motorist only the simpler adjustment of aiming should increase the number of cars with properly adjusted head-lamps and should assist materially in regaining the cooperation of car-owners in improving head-lamp conditions throughout the country.

The accurate construction and easy adjustability of automobile head-lamps, though they have received much attention, are still susceptible of further improvement. If motorists realized that the road would be illuminated better, objectionable glare could be avoided and a better and safer head-lamp would be produced by properly adjusting the head-lamps now in service, an immediate and far-reaching improvement would be effected.

The requirements are given for the uniform and satisfactory service of lamps and of such parts as filaments, sockets, reflectors, lenses, doors and mountings, the un-



William P. Kennedy

Joseph Anglada

derlying idea being the use of devices that will obviate the necessity for focusing and leave to the motorist only the simpler adjustment of aiming.

THE head-lamp is a very sensitive device. The distances from the filament to the reflector and the lens are so short as compared with the distances ahead of the car to which the light is projected that satisfactory results cannot be expected with inaccurate or poorly adjusted equipment.

Even when the equipment is good, the problem of securing proper adjustment still remains. Greater simplicity will help in its solution. The proper adjustment of all devices in general use today necessitates both focusing and aiming.

In the discussion which followed, the Motor Vehicle Commission of New Jersey, was represented by J. J. Shanley. He stated that eleven states comprising all of New England, with the exception of Rhode Island, but also including Maryland and Ohio, had jointly agreed on the code adopted by the committees of the Illuminating Association and the S. A. E. Further, this code is eminently satisfactory and bids fair, if complied with, to be of an enduring nature. He also emphasized the need for dealer and driver education to offset the possibility of more drastic legislation.

The Bureau of Standards was represented by Dr. Sharpe who presented an illustrated discussion of findings of a nature similar to those of Falge and Shanley.

As the result of their investigations, the Bureau has found that 60 per cent of head-lamp adjustments on new cars in the hands of ultimate users are extremely incorrect and dangerous, 34 per cent are passable and but 6 per cent are correct. The members of the Bureau strongly recommend the establishment of state operated inspection and adjustment stations, where the user may have his lamps corrected to suit the requirements of the law and personal and public safety.

Cooperation of the manufacturer was assured by Al. Reeves of the National Automobile Chamber of Commerce, who advanced a plea for more adequate notice of new legislation by various states. That the head-lamp



C. W. Spicer

G. L. Norris

Major W. G. Wall

situation is of serious nature was borne out by his statement that no less than 43 state legislative bodies now have motor vehicle head-lamp legislation in their calendars. In view of this fact, he is inclined to doubt the economy of skimping on the head-lamp design and installation and stated that the increased cost of a satisfactory, legal equipment would undoubtedly be an excellent insurance against future expense and legal complication.

Several members of the Society discussed various phases in agreement with the opinions of the previous speakers. All were entirely in favor of supporting measures which would result in making head-lamps meet the requirements of the joint code which forms the common ground between the manufacturers and many states. New State legislation is everywhere tending toward the adoption of this code. If the manufacturer will realize on his opportunity by better original equipment where it is required and make the benefits available to the user by educating dealers and, finally, users, the possibility of more drastic laws will become increasingly remote.

Keen Competition Features Sporting Events at Meeting

Pleasure enhanced by arrangement of program which enabled schedule to be run off with plenty of time. Golf draws greatest number of competitors. Metropolitan members excel.

GOLF again attracted more competitors than any other sport, but all of the events were well patronized. Gordon Brown of the Condensite Co. earned the title of all-round champion by winning the greatest number of individual points, while the Metropolitan representatives ran away from the other sections by accumulating 124½ points as against 101¾ for Cleveland and 96 for Detroit.

Pleasure in athletic activities was greatly enhanced by the increased amount of time devoted to them. All of the tournaments were started promptly and the final rounds were completed without difficulty before the close of the convention. A number of ladies' events were staged in addition to the men's activities. The Sports Commit-

tee, headed by Mason P. Rumney, deserves considerable credit for the efficiency of its efforts.

Results of some of the more important sporting events were as follows:

Golf

I. W. Danforth defeated D. W. Meigs 2 up in the finals of the championship flight. C. E. Dwyer defeated C. S. Salzman for the Class B championship. B. S. Gier won the Class C flight by defeating Joseph Bijur in the finals.

W. R. Flannery was first in the driving contest, with Sanford Brown second. The putting contest was won by Sanford Brown. C. T. Myers was second and C. H. Foster third.



A. L. Reeves B. W. Meigs F. W. Davis I. W. Danforth
Meigs defeated Reeves and Danforth beat Davis in the semi-finals of the golf tournament. Danforth won from Meigs 2 up in the finals

Trap Shooting

W. H. Miller won the trap shooting championship, having compiled the best total score for three days' shooting.

A prize was awarded to the winner for each day. W. H. Miller led the field on Tuesday, R. S. Ellis on Wednesday and H. B. Hobart on Thursday.

Baseball

The Detroit Section won the baseball championship by defeating the Indiana-Midwest combination 6 to 4 and the Cleveland Section by a score of 8 to 7.

Swimming

Gordon Brown, the all-around champion, was the individual star of the swimming meet. He accumulated firsts

in the 33- and 66-yard swims and in several other events. L. C. Hill won the plunge for distance and S. M. Lee the fancy diving contest.

The sectional relay race went to the Metropolitan Section team composed of Gordon Brown, Sanford Brown, N. MacCoull and Ira Snead.

Tennis

Norman G. Shidle defeated Coker F. Clarkson in the finals of the men's singles 7—5, 6—1, 6—1, while Herbert Chase and Shidle defeated Clarkson and Henry M. Crane by scores of 6—4, 6—4, 6—1 in the finals of the men's doubles.

Horse Shoe Pitching Contest

The horse shoe pitching contest was won by H. M. Parsons. W. L. McGrath was second and A. D. T. Libby third.

Field Events

Following is a list of the winners of some of the more important field events:

50-yd. dash, men under 30—E. O. Jones.

50-yd. dash, men 30 to 40—N. McMillan.

50-yd. dash, men over 40—R. Abell.

Fat man's race—T. V. Buckwalter.

Three-legged race—N. McMillan and E. O. Jones.

Potato race—N. McMillan.

Shot put—T. V. Buckwalter.

Hop-step-jump—B. W. Brodt.

Standing broad jump, men under 40—R. M. Powell.

Standing broad jump, men over 40—T. V. Buckwalter.

High jump—J. C. Talcott.

Intersectional relay race—Detroit (N. McMillan, E. O. Jones, F. F. Kishline, B. W. Brodt).

Side Lights on the S. A. E. Summer Meeting

AKRON brought balloon tires to the meeting but Dayton provided the balloon. A captive member of this species was hitched on the lawn in front of the Monmouth on Friday afternoon. Members and their friends who tried out the single seater car attached seemed to be more interested in the sensation of flying than in the hand operation of the helicopter propellers. As the hydrogen filled gas bag deprived the birdmen and their spectators of their regular smoking privileges, some of the nervous tension may be explained.

Speaking of smoking, the Cleveland Section passed out cigarets before dinner, one evening. The brand was a well known one which was enjoyed by the ladies as well as by the men. The only disgruntled customers were the late arrivals who rushed in from golf or tennis after the available supply had been consumed.

The relation of ignition and turbulence was demonstrated by the Metropolitan Section in a very interesting session. Late Thursday evening, some of the members and their wives and friends who were practising dancing at the Monmouth suddenly suspicioned that the Volstead fleet was staging a bombardment offshore. Upon rushing to the front porch, they discovered that an elaborate display of fireworks was the cause of the bombardment. This exhibition was a new departure in the way of sectional entertainment and made a great hit with the youngsters, no less than with the engineers assembled.

Among the numerous pairs of Siamese twins at the meeting were Alfred Reeves and M. L. Heminway, the capable

general managers of the N. A. C. C. and the M. & A. M. A. They roomed together, played golf together and attended meetings together. Heminway watched all kinds of sporting events as well as the beauties of the beach. He complained that his feet hurt him. Reeves got away to a bad start. The first night there he had toothache. The next afternoon, when he started to incase himself in immaculate white flannel trousers, he found the tailor had sent him a pair designed like a tent and entirely too commodious for his somewhat slender figure.

A wireless message was received from F. E. Moscovics, one of the hand picked guests on the maiden cruise of the dry but luxuriously reconstructed Leviathan. He said he was inspecting the huge ship to see that it conformed to the S. A. E. standards and that he had found the fuel volatility was running high.

During the course of the aquatic sports, two of the mermaids of the American Olympic swimming team delighted the audience with an exhibition of real swimming and plain and fancy diving. A course of private instruction can be recommended to at least one amphibious member of the Metropolitan Section.

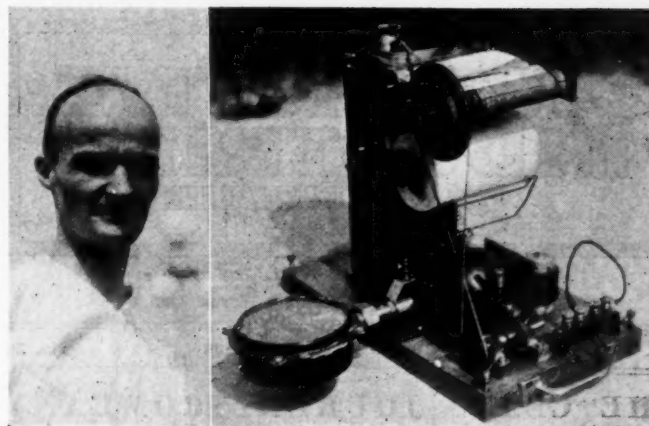
That four-wheel brakes are no protection against the Jersey police was learned by M. Guillemon. While demonstrating the merits of the servo-mechanism on his big Renault, Guillemon was picked up by a motor cop who testified to a speed of 60.2 m.p.h. The judge released M. Guillemon with an admonition and a \$25 fine without the inconvenience of a term in the local jail.

A wide variety of cars in the middle and upper price classes were shown with four-wheel brake equipment. A few of these were factory exhibits, but most of them belonged to four-wheel brake companies or private owners. Among the cars at the meeting equipped with the new brakes were a Packard, a Cadillac, a Renault, a Buick, and a Pierce-Arrow.

W. S. James of the Bureau of Standards aroused considerable interest with a new accelerometer of simplified construction. The instrument is designed to be of assistance to State or municipal inspectors in testing brake efficiency.

Golf and tennis players at the meeting owe a debt of gratitude to Mack Trucks, Inc., for the buses which transported athletes from the hotel to the various battle fronts. The buses rendered highly efficient service.

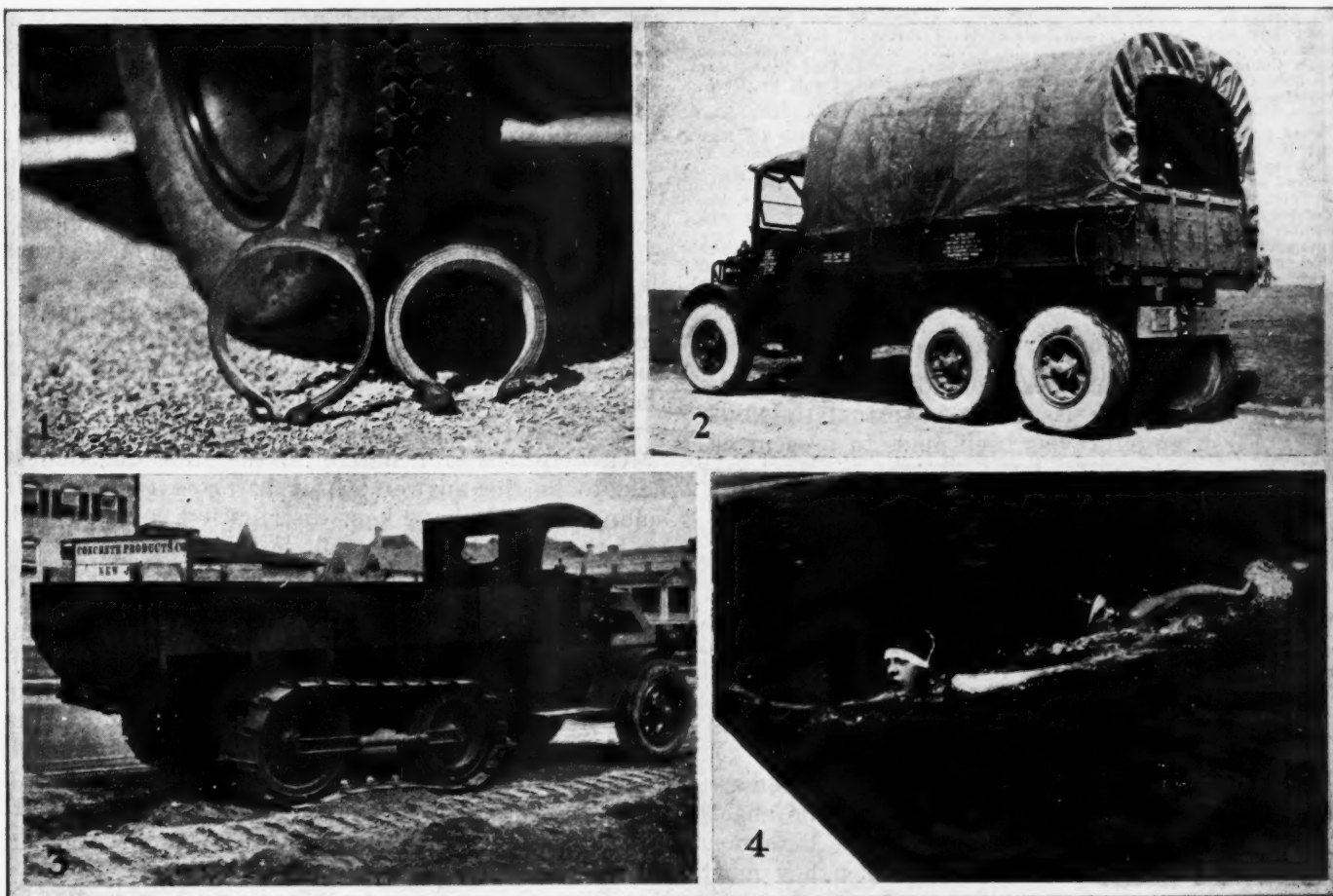
A five-ton Mack truck equipped with a detachable caterpillar tread was demonstrated by the Cement Products Corp. The tread, which consists of a continuous belt of hinged steel castings, is driven by standard dual solid tires at the rear wheel. Duplicate wheels, which are mounted on a dead axle located by radius from the rear hubs, carry the forward end of the tread. This arrangement may be applied to any standard chassis by the addition of brackets to the existing frame.



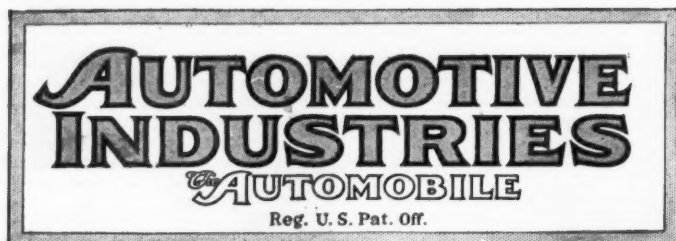
W. S. James of the Bureau of Standards and his simplified accelerometer

One of the exhibits was a six-wheeled 5-ton truck which is the product of the Quartermaster Corps, U. S. A. The wheels were shod with pneumatics all around. It is stated that pressures developed at 6 in. under the surface of the highway are about half of those resulting from the 3½-ton Class B truck. In the judgment of the Quartermaster Corps, this difference in resultant pressure increases the possible use of existing roads in the United States by 200 per cent. This truck is made largely of commercial or slightly modified standard units.

A Few Special Features at Spring Lake



1—A closeup of one of the balloon tires. 2—A six-wheeled 5-ton truck was shown by the Quartermaster's Corps. 3—This creeper attachment for trucks was viewed with interest by the engineers. 4—An exhibition of swimming strokes and diving by Miss Eileen Riggan and Miss Ethel McGary got a lot of attention



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Automotive Industries—The Automobile is a consolidation of The Automobile (monthly) and the Motor Review (weekly), May 1902, Dealer and Repairman (monthly), October, 1903, and the Automobile Magazine (monthly) July, 1907.

TWO objectives have been sought in preparing this 1923 engineering issue of AUTOMOTIVE INDUSTRIES. First, an effort has been made to present authoritative opinions about the engineering topics of greatest current interest; second, an attempt has been made to give the issue a special reference value by publishing drawings of some of the most interesting parts designs brought out in recent months.

Our readers must judge how well these two purposes have been achieved. We shall be glad to receive comments of any kind.

Making Roads to Fit Loads

IF legislators are to act intelligently in the enactment of laws designed to preserve the highways from needless damage by motor vehicles they must have scientific data upon which to predicate their decisions. Some of this information, happily, will be supplied by exhaustive tests which have been undertaken by the Bureau of Standards, the Bureau of

Public Roads, the N. A. C. C., the S. A. E., and other automotive bodies.

Considerable progress has been made by highway engineers in the past few years in measuring the relative wearing qualities of various road materials under different traffic conditions and they know much better how to suit roads to soil conditions. Up to this time, however, most of the blame for damage to highways has been attributed to overloaded motor vehicles.

Overloading admittedly is an evil which should be stamped out, but little attention has been given to the true economics of the situation. The primary purpose of road builders and the automotive industry should be to provide the most economical highway transport. It is quite possible to go so far in making loads fit the roads, rather than roads fit the loads, that the result will be uneconomical.

There should be a happy medium. When the tests are completed it may be possible to find a middle ground upon which all elements—political, economic and transportation—can meet in entire harmony.

Moline Plow Hurls a Bomb

MODERNIZATION of distribution methods in the farm implement business is proposed by the Moline Plow Co. In setting forth its plan, which is based upon cash purchases by distributors, with sales by them for cash, the company contends that it will save dealers 10 per cent and predicts that it will result in the "slashing" of prices by competitors. Greater profits for dealers will be made possible by reduced selling costs for the manufacturer. The big question before the industry, the company asserts, is:

1. Is the retail business to be in the hands of an independent and prosperous merchant, master of his own business and personal owner of the confidence, good-will and respect of his customers and colleagues in business? or,

2. Is it to be conducted by unprosperous manufacturers' agents, who lose their individuality and the good-will of their customers in the domination of their suppliers and take from the manufacturer they serve a doled out pittance for their pay?

An emphatic affirmative to the first question is held to be the answer. It is asserted that archaic selling methods have kept distribution costs so high that there has been no profit left for the dealer.

"Exaggerated investment, crossroad agencies, armies of salesmen, shippers, canvassers, accountants, collectors, warehousemen, experts, clerks, credit men, excesses of small shipments and accounts, branch houses, warerooms, managers, overhead—the whole mass of foolish waste—all should have followed the Indian and the buffalo," the Moline company protests.

Another result of wasteful distribution methods, it is stated, has been to keep up prices to the consumer.

In announcing this plan, which is somewhat revolutionary for the farm implement industry, the Moline Plow Co. seems to be adapting to its needs the methods which long have been in vogue in the automotive industry. It should be congratulated upon its courage in taking so bold a step.

The Engineer—An All 'Round Industrialist

IN this industry the engineer occupies a position somewhat different from that held by similar men in other mechanical developments. From its inception the automobile, as a mechanical contrivance, has been affected in its improvement by the market reactions and the production necessities.

Standardization and interchangeability of parts were matters not essentially agreeable to the engineer from the viewpoint of design development but of the utmost value to production speed and the quicker satisfaction of a waiting market.

New discoveries in the mechanical structure, accessories or conveniences of the machine were encouraged and developed by the action of the individual car buyer in his ready acceptance of these advantages and his expressed preferences for their use.

The trend of engineering development has been influenced by these quick and constant market and production influences as in no other industry involving serious mechanical problems.

The user of all machines is the final arbiter of the value of engineering advances, but in most other lines the user is a trained man and the machines are used by experts under the controlled conditions of industrial usage.

The car owner is the final arbiter of that which constitutes the greatest value for the money expended, but he is not trained as a mechanical expert and does not use the machine under controlled conditions. For that reason his influence has been more direct, more vicarious and less easily translated into technical terms.

Design, production and merchandising in this field are so closely inter-related that no full consideration can be given to one without involving the other two. No discussion of one is possible without introducing the other factors.

Moreover, this industry is still so young that it has not yet passed the formative period and its future tendencies must be seen from a consideration of all three branches.

The engineer who is interested in the automotive industry, therefore, has many important reasons for a definite study of the general features and tendencies in production and merchandising. He cannot afford to regard these subjects as outside his consideration or their tendencies as of little or no effect upon his practice.

In some way or other they do enter into all his practical calculations and speculations and the current study of them will bring them into those calculations more accurately and definitely. In practice, moreover, the use of the term engineering is being extended to cover almost all of the activities of the manufacturing.

Because the term "engineering" is synonymous with analytical or scientific approach to business—in the thinking of most men—they have seized and applied the term to the analytical necessities of every part of the business. So we come across terms like "production engineering," "human engineering," "industrial engineering," "sales engineering," etc.

Such uses may destroy the value of the term in its more specialized and technical meaning, but they serve to illustrate how thoroughly the problem of manufacturing is confronted with the same necessities all through its operations. They do not emphasize sufficiently the fact that manufacturing needs—not the composite studies of a number of specialists only—but the properly related understanding of these activities and the objectives.

Some years ago a very able nurse, superintendent of her work at one of the large hospitals, made the remark that there were many doctors who knew the eyes, throat or stomach, but too few who knew the human body.

Something of the same problem exists in business and is one of the problems in so large an industry with so short a history.

The engineer must study the movements in production and merchandising for his own necessities in design and development. He should study these things in order to get a logical understanding of the factory as a whole.

Truck Gains Shown in Parts Activity

Curve Likely to Continue Upward
When Car Operations Begin
Slowing Down

NEW YORK, June 25.—Orders placed with parts makers promise a continuance of capacity operation in many of the unit producing plants for a month more at least, earlier indications that there would be signs of a lull after the first of June with a more pronounced drop beginning with July not being borne out. Production has shown an exceptionally well-sustained upward curve covering an unusually long period. Makers are now exerting all efforts toward maintaining deliveries at the mark warranted by the present pressure from car and truck producers.

August may see a change in the direction of the curve, but the decline in parts production is not expected to show itself before then, unless there comes a general slowing up in demand for cars and trucks.

While car manufacturers take a prominent place in the high operations of the parts branch of the industry, truck builders are probably a more important factor in enabling schedules to be kept at a high mark.

Demand Probably Will Last

The demand for motor trucks shows an increasingly wholesome tone which presages continued activity in manufacturing operations after the downward slant has started with automobile production. This has been apparent since the upward swing of general business conditions and the opening of new fields for truck use. Rail cars and motor buses continue to be called for in large volume. The development of the move toward wider use of motor buses has strengthened considerably the position of truck manufacturers as has the growing tendency of railroad operating companies to adopt gasoline rail cars.

Truck production for May of this year is now estimated at 42,983, as compared with 23,788 for the same month of 1922 and 37,527 for April, 1923. March output reached 34,681, against 21,817 in February and 19,398 in January. For the first five months, output aggregated 156,406 as contrasted to 88,502 for the similar period a year ago.

Major automobile manufacturers report production at levels that follow closely the schedules of last month.

(Continued on page 1443)

Business in Brief

NEW YORK, June 28.—Lacking definite leads to indicate the trend of business operations, the general policy of caution still prevails. Weather conditions have been such as to retard some business activity and the customary slowing down for the summer months is at hand. Definite action in the industrial field in general now awaits the passing of summer and more exact knowledge of crop conditions.

Crops in general have benefited by weather conditions and some lost growth has been made up. The price situation is not very favorable to the farmer. While corn prices have reached the highest point of the year, grains have fallen to the lowest point. Great uncertainty reigns in the cotton market and exports have decreased.

Conditions in the iron and steel industry remain practically unchanged. Orders continue to come in in sufficient volume to keep mills operating at a high level. Production on the whole is slackening, due in large measure to the hot weather and to a desire to make repairs. Slight softening in prices has been noticeable, chiefly among the independents.

Car loadings for the week ending June 9 aggregated 1,013,249 cars, or an increase of 81,208 cars over the week previous. This is the second time this year that loadings have exceeded a million and it is the fourth largest loading on record. Manufactured products showed an increase of approximately 3500 cars and grain products gained. This record loading is a good measure of the prosperity of the immediate past.

The granting of higher wages to the New York bricklayers has stimulated building operations in that city.

Fisher Makes Shepard Art Part of Ternstedt

Latter Will Assume Direction of
Division with Paul W.
Seiler at Head

DETROIT, June 27.—The Shepard Art Metal Co. has been combined with the Fisher Body Corp. as a part of the Ternstedt Manufacturing Co. and will hereafter be known as the Shepard Division of the Ternstedt company. C. B. Shepard, who has been in charge of the Shepard company, has resigned, and the direction of the company will be assumed by the Ternstedt organization, headed by Paul W. Seiler.

The announcement of the change was as follows:

Fred J. Fisher, president of the Fisher Body Corp., announced today the acquisition of the Shepard Art Metal Co. by the Ternstedt Manufacturing Co. Both of these companies have for a number of years been owned by the Fisher Body Corp., and the amalgamation of the two companies is made with the view of effecting economies inherent in such a combination.

The Shepard Art Metal Co. has in the past been one of the largest and best known companies devoted to the production of high-grade interior fittings for closed motor cars. The combination thus effected will enable the Ternstedt company to offer a complete line of both mechanical body equipment and interior fittings.

New Shepard Plant

The Shepard plant, which in the future will be operated by Ternstedt as the Shepard Art Metal Division, will, upon the completion of the plant now under construction, have a floor area of over 200,000 sq. ft. and will give Ternstedt an aggregate floor area far in excess of 1,000,000 sq. ft. of manufacturing floor space. The production of interior fittings will be continued in the Shepard plants.

New York and Chicago Salon Dates Announced

NEW YORK, June 26.—Announcing that the nineteenth annual Automobile Salon will be held at the Commodore, New York, Nov. 11 to 17 and at the Drake in Chicago Jan. 26 to Feb. 2, inclusive, the management says that fifteen exhibitors have contracted for space.

The list includes Cunningham, Daniels, Hispano-Suiza, Isotta Fraschini, Lancia, Minerva, Renault, Rolls-Royce and Voisin of foreign make.

Among American cars to be shown by body builders are Cadillac, LaFayette, Lincoln, Locomobile, Marmon, Packard and Peerless.

Custom coachwork builders with special exhibits are Fleetwood, Holbrook, Kellner, Le Baron, Seaman and Rubay.

Assets of Crow-Elkhart Sold to Century Motor Co.

ELKHART, IND., June 27.—The Century Motor Co. of this city, owned by M. E. Hoshaw, Peter T. Longacher and F. E. Hughes, has bought at a trustee's sale the assets of the Crow-Elkhart Motor Corp. for \$78,700, subject to a mortgage, and special assessments totaling \$16,000 on the twenty-six-acre land tract. The total liabilities of the Crow-Elkhart company are about \$800,000 and it is said that general creditors and stockholders will get nothing, while noteholders will receive about three cents on the dollar.

The Century company has been manufacturing the Morris London for export.

Horace De Lisser, Ajax Founder, Dies

Ill for Brief Time—Was Ajax
Chairman and Also Head of
Rubber Association

NEW YORK, June 27—Horace De Lisser, founder and chairman of the board of directors of the Ajax Rubber Co., and president of the Rubber Association of America, died at his home in this city yesterday after a brief illness resulting from a nervous breakdown. Mr. De Lisser was one of the pioneers in the tire industry, dating his connection from the old bicycle days.

His first association with the industry was in 1896 when he became identified with the International Tire & Rubber Co. of Milltown, N. J. When Michelin took the company over in 1899, Mr. De Lisser went with it and continued his connection with Michelin until 1902. In that year he organized the Ajax Standard Rubber Co. which became the Ajax-Grieb Rubber Co. in 1906 through a combination with the Grieb Rubber Co. Nine years later this company became the Ajax Rubber Co.

Mr. De Lisser served as president of Ajax from its inception until the time he left to become vice-president of the United States Motor Co. During his association with the latter company, however, he did not sever his entire connection with Ajax but continued as a director.

His association with the Rubber Association began with the formation of that organization and just prior to his election to its presidency the first of this year he served as first vice-president.

He was born in Kingston, Jamaica, fifty-six years ago and came to this country when he was ten years old.

Columbia Capitalization to Be Cut to \$3,000,000

DETROIT, June 27—Stockholders of Columbia Motors Co., at the annual meeting this week, voted to reduce the capitalization of the company from \$6,000,000 to \$3,000,000 and issue shares of no par value. President J. G. Bayerline said the new stock will be placed on a dividend basis later. A. R. Demory, former president of the Timken Axle Co., and C. R. Talbot, vice-president of the National Bank of Commerce, were elected to the board of directors.

In the report to stockholders, Theodore Barthel, secretary, and George Martin, treasurer, said that the company had operated at a profit for the last twelve months, and that during the first four months of this year there were shipped from the factory 22 per cent more cars than during any like period for more than nine years. Reports from dealers and distributors indicated that this good business could be expected to continue.

The stockholders also approved the

Cost of Maintenance Will Be a Greater Factor in Sales When Experience of Owner Becomes More Complete

By H. H. RICE,
President of the Cadillac Motor Car Co.

Detroit, June 26.

BUSINESS has had its recession for the year, somewhat more of a recession than the situation demanded apparently, for it has resumed, after its short setback, on a vigorous scale and promises continuous development through the remaining six months. There is little possibility of inflation because the business forces of the country are too alive to its disastrous consequences. The brief falling off we have just had indicates that the situation will not be permitted to get out of hand. In my opinion the check was somewhat too drastic but it served the purpose and business has resumed quickly.

Throughout the grain country we have the promise of abundant crops and greatly increased prosperity in the latter part of the year. Railroad executives report conditions in sections reached by their lines as favorable for big business and they are rallying their forces to be prepared to handle shipping imposed on them by large crops. The successful movement of crops this year will be an important factor in the business of the late year.

It is reported by rail executives that farmers are ready to enter the market and that the general feeling among farmers tends toward extensive buying when their crops are marketed.

Good general business will mean a continuance of the heavy automobile buying of the year. Although the largest part of this, of course, will fall to the lot of manufacturers in the smaller car classes, there will be proportionately increased buying in the high priced lines. Every buyer of a low priced car is a possible ultimate purchaser of a high priced car, although the movement toward the high priced is more gradual and steadier and not so much affected by year to year influences.

Generally prosperous conditions set up a rush of buying in the lower priced lines, while the purchase of a high priced car is usually a matter of considerable deliberation. Although a man may arrive at a point where his circumstances would warrant the purchase of a better car than the one he owns, he waits until he is certain that he can afford it. There is far less hesitation in the purchase of lower priced cars.

Although the first cost of an automobile continues to be the dominating factor in the purchase there is more thought being given to the possibility of ultimate saving through the lower maintenance and longer life of higher priced vehicles. This has not reached a point where it is reflected in the buying but as the experience of owners becomes more complete it will create buying among many persons who have been giving first cost primary consideration.

Reduction of initial payments on higher priced cars and spreading the payments over a longer period probably would have the effect of creating a larger volume of buying but I do not think manufacturers would find it advisable to create business this way. Present periods of payment are not too short for persons legitimately buyers in this field. It would be better for a buyer to defer his purchase until he could make it under the regular plans.

proposition to bid for the property of Liberty Motor Car Co. at receiver's sale July 3, and efforts will be made to purchase the property at private sale prior to that date. If the deal is consummated, 83,334 shares of new stock would be sold at \$6 a share, 20 per cent of this amount being already subscribed contingent upon acquisition of the Liberty properties.

Millionth Bowser Pump Produced During June

FORT WAYNE, IND., June 27—S. F. Bowser & Co., Inc., manufacturer of pumps and tanks, turned out its millionth pump this week, observing the event by closing the plant for half a day and holding a celebration at Weisser Park, attended by 4000 persons. The pump will be mounted on a pedestal in front of the company's offices. Business this year will approximate \$12,000,000.

Trust Estate Operates Factory of Rotary Tire

ZANESVILLE, OHIO, June 26—The Hubbell Rubber Co., a trust estate, has been formed in this city with Charles C. Hubbell as president to operate the former plant of the Rotary Tire & Rubber Co., erected just outside the limits of Zanesville, about four years ago. The deal for taking over the plant was completed May 10, and steps were taken to put the plant into operation, which was done about June 1.

The organization is known as a common law trust and has as trustees Charles C. Hubbell, H. M. Donaldson, who is vice-president; E. E. McCloud, who is secretary; T. E. Diltz, who is treasurer, and H. E. Elliott. As soon as the friendly receivership of the Hubbell Rubber Co., an Ohio corporation which never operated, is closed up, Hubbell plans to charter a company to be known as the Hubbell Rubber Co.

Barley Now Roamer; Has Big Cab Order

Stock of Company, Representing
a Consolidation, Will Be
Listed on Exchanges

KALAMAZOO, June 25—Organization of the Roamer Motor Car Co. which consolidates the interests of the Barley Motor Car Co. and the Kalamazoo Realty Co., is announced by President A. C. Barley.

The new company has an authorized capital of 300,000 shares of no par common, of which 200,000 shares are to be issued immediately and listed Monday morning on the New York Curb and the Boston Stock Exchange. The company will also carry in the treasury \$1,000,000 of preferred stock, which may be issued later.

Reports New York Order

In connection with this campaign of refinancing, announcement is also made that a \$19,000,000 contract has been closed with Diamond & Murphy, a New York distributing house, for Pennant taxicabs for delivery during a five year period, 1200 of which are for delivery during the current year. Other large orders have also been placed in Philadelphia, Cincinnati, Pittsburgh and other metropolitan centers.

In addition to the extensive manufacture of taxicabs, the company also reports a rapidly growing demand for Roamer and Barley motor cars.

The Roamer Motor Car Co.'s refinancing campaign has been in progress for several weeks. It was conducted jointly by the executives of the company; Olmsted & Mulhall, Kalamazoo; Corrigan, Hilliker & Corrigan, Grand Rapids, and a representative New York house. The Chatham & Phoenix National Bank will act as transfer agent in New York and the Metropolitan Trust Co. as registrar. In Boston the National Shawmut Bank is registrar and the Old Colony Trust Co. transfer agent. Listing of the stock will give the company's securities a wide market and a national distribution which they have not hitherto enjoyed.

Stockholders Get New Shares

The exchange of stocks has been effected, holders of preferred and common stocks in the old companies being given the option of converting their securities into those of the new corporation or accepting cash. With few exceptions those interested in the old companies have chosen to accept securities in the new concern.

The Roamer Motor Car Co.'s new directorate includes A. C. Barley, president; George B. Hopkins, treasurer; W. S. Perkins, vice-president of the

COORDINATION URGED IN PRESIDENT'S TALK

KANSAS CITY, June 23—President Harding, in an address in this city last night, touched upon motor transportation in advocating the coordination of this service with the railways. He said:

"We have not fully appraised the evolution from the ox-cart to the motor age. The automobile and motor truck have made greater inroads on railway revenues than the electric lines with their intimate appeal to the local community. There will never be a backward step in motor transportation.

"But we shall do better if we find a plan to coordinate this service with the railways, rather than encourage destructive competition. Indeed, the motor transport already promises relief to our congested terminals through better coordination.

"We have come to the point where we need all the statecraft in business to find the way of making transportation in its varied forms adequate to the requirements of American commerce, to afford that transportation its due reward for service, without taking from production and trade a hindering exaction."

Chatham & Phoenix National Bank, New York City; W. S. Thomas, president of the Thomas-Daggett Canning Co., Grand Rapids; J. W. Stephenson, president of the Indiana Truck Co., Marion, Ind.; Charles A. Blaney, Wheeler-Blaney Co., Kalamazoo, and Charles Bard, wholesale steel and iron, Kalamazoo.

William Elliott Phelps will continue as general sales manager.

Commenting on the refinancing campaign just completed, Thomas E. Mulhall of Olmsted & Mulhall said:

Roamer Motor Car Co.'s stock (no par) to the amount of 54,500 shares will be offered Monday morning on both the New York Curb and Boston Stock Exchange. That is the unsold portion of 200,000 shares of no par issued and sold as authorized. The remaining 145,500 shares outstanding represents the holdings of present stockholders. The company was able to show net profits of \$78,000 for April and May and the outlook for the future is very flattering.

The report of the American Appraisals Co. gives the value of factory, site and equipment in Kalamazoo at \$704,502.

CANADIAN REGISTRATION

WASHINGTON, June 28—Canadian automobile registration has passed the half million mark, according to figures of the Ministry of Trade forwarded to the United States Department of Commerce. Total registration as of June 30 is given as 514,000.

Barrows of Premier Also Heads Monroe

New Company Will Move from
Present Small Plants—Line
to Be Enlarged

INDIANAPOLIS, June 26—Monroe Motors, Inc., has been organized to continue the production of the Monroe car, with Frederic I. Barrows, president of the newly reorganized Premier Motor, Inc., as president. Strattan Motors Corp. last week announced that it had disposed of its interests in the car to the new company and will center all its activities on the production of the Strattan.

Charles Warfel is secretary and purchasing agent of Monroe Motors; Berkely Orr, treasurer; E. B. Brown, superintendent, and G. C. Patrick, engineer.

According to Barrows the company has a capital stock of 50,000 authorized shares, no par value, with 20,000 issued and 30,000 in the treasury for future disposition.

Leases Space in Premier Plant

Because of the need of additional room for manufacture and development, a section of the Premier plant in this city has been leased by the new company, and business will be carried on there instead of in the two small plants heretofore occupied.

In announcing plans of Monroe Motors, Barrows said:

The officials of the Monroe institution announce that experimental work is well under way for the production of other models than those now offered by the Monroe line. Two eminent consulting engineers have been invited to make reports on the models and every progress is being made in the presentation of a light, quality production job at an economical cost. These plans absolutely require more space than the old Monroe plants offer and hence the lease of a part of the large Premier plant.

Distribution contracts have already been signed at a number of important places and with new financial facilities and an increased line of cars, additional capital investment and considerable new blood in the organization, the management looks forward to a prosperous year.

Comet Plant Not Sold; Patent Rights Disposed of

DECATUR, ILL., June 23—Eight hundred lots of the Comet Automobile Co., ranging from practically new cars to small parts, were sold to out-of-town supply and accessory houses, bringing nearly \$56,000, exceeding the guarantee by nearly \$10,000.

The appraised value of the property was \$145,000. Moses & Morris Motors Corp., Chicago, bought the good-will and patent rights which included service to Comet car owners. There were no bidders when the company was offered as a whole. The plant will not be sold.

"Logangear" Maker Acquires New Plant

Arrangements Made with Modern Glass Co. Stockholders
—Heavy Orders Reported

TOLEDO, June 25—Acquisition of a large plant here by the Kauffman Metal Products Co. of Bellefontaine was announced here yesterday when tentative arrangements were made whereby the stockholders of the defunct Modern Glass Co. would purchase their plant at receivers' sale and then join in a consolidation of the property with the Kauffman interests.

The Kauffman company plans to enlarge its capitalization from \$127,000 preferred stock to \$500,000 of 7 per cent preferred stock which will share with common dividends up to 10 per cent, and 1000 shares of no par common will be increased to 5000 shares of no par common.

The Kauffman plant at Bellefontaine now employs 150 men and has almost ten times as many orders as its present capacity can take care of, it is reported. It manufactures automobile fly-wheel steel gears under the trade name of "Logangears."

It is understood that the Kauffman interests have equipment orders placed for the new plant and will be able to get into production here promptly upon completion of the deal.

There were more than 4000 Toledo stockholders in the old glass company which never really got started in business after its promotion. Many of them have signified their willingness to enter into the purchase of the plant on which the court has set an upset price of \$150,000.

Denby Truck to Occupy New Plant by August 1

DETROIT, June 25—Denby Motor Truck Corp. will move into its new plant at Dodge and Kercheval Streets, this city, by Aug. 1 and will be in production there immediately thereafter. The new plant will give the company 43,000 sq. ft. of manufacturing space, with a capacity for about 3000 trucks annually, which compares about equally with the present plant. In addition the company will have an acre of ground for new building development.

Denby business is showing steady gains, said S. H. Hale, vice-president and general manager, the demand running mostly for the 2-ton vehicle. Business is generally from industrial and business sources, the Pacific Coast reflecting the best sectional buying. Farmer truck buying has been light, Hale said, so far as the Middle West is concerned, this being due principally to insecurity of wheat prices.

The plant from which Denby is moving

REVENUE FROM TAXES ADVANCED IN MAY

WASHINGTON, June 25—According to the figures compiled by the Bureau of Internal Revenue, \$1,215,509 was collected in excise taxes on motor trucks in May of this year, an increase of \$234,987 over the same month last year.

Taxes collected on passenger cars and motorcycles for May, 1923, totaled \$12,079,341 as against \$6,834,472 for the same month in 1922.

On automobile accessories and parts the amount collected in excise taxes totaled \$3,503,587 for May, 1923, as compared with \$2,683,883 for the same month in 1922.

was purchased by L. A. Young Industries, Inc., and has been occupied under lease by Denby until this time. On the removal of the truck company, Young Industries will take over the plant for the general extension of its manufacturing.

Paige-Jewett Dealers Get Distribution Data

DETROIT, June 26—A summary of Paige-Jewett sales in May reported to the distributing department shows the largest percentage of cars, 11.3, to have gone to executives and manufacturers, the next, 10.3, to foremen, machinists, plumbers, millmen, miners, blacksmiths, and the third largest, 5.7, to farmers. A complete percentage of classification of other buyers shows:

Merchants, 5.6; building trades, 4.7; women, 4.2; salesmen, 4.1; physicians, 4; real estate and insurance, 4; railway employees, 4; hotel and restaurant proprietors, 2.9; automobile trade, 2.7; clerks, 2; taxi, 2; printers and publishers, 2; bankers and brokers, 1.9; retired, 1.9; oil trade, 1.9; groceries and meats, 1.8; druggists, 1.2; teachers, 1.1; lawyers, 1; barbers, 1; bakers, 1; Government and municipal, 0.9; engineers, 0.8; miscellaneous, 0.4; occupation not given, 12.

In presenting this list to its dealers the company asks that they check it over and compare their own sales by occupations with these. They are urged to give every group of buyers the attention it deserves. The attention of dealers is especially directed to prospective business in the building trades and among women holding responsible positions.

NEW YORK STATE SALES GOOD

SYRACUSE, N. Y., June 26—This spring has been one of the biggest in the history of the automobile business in central New York. Syracuse dealers showed an increase of 61.8 per cent in new car business for May as compared with May, 1922.

Overland Stock Sale Opposition Renewed

Toledo Interests Not Favorable to
Disposition by Willys Corp.
Receiver

TOLEDO, June 25—Toledo interests will wage a strong fight against the confirmation of the sale of the block of 739,866 shares of common stock of the Willys-Overland Co. by receivers for the Willys Corp. at the upset price of \$3,000,000, set by Judge Knox in Federal Court at New York.

It was announced a few days ago that Receiver Francis G. Caffey had received an offer to purchase the stock from the merchandise, construction and bank creditors' committees in New York.

At present market price the stock is estimated to be worth about \$4,500,000, and it is not thought the court will approve the sale at a hearing scheduled for Friday, June 29.

Already 78 per cent of the approved claims of the company have been paid, and there are other assets not liquidated. Sale of the Willys-Overland stock, however, would furnish enough cash to pay all claims entirely and permit lifting the receivership.

The company is making such excellent progress now that it is expected the stock will greatly enhance in value if it is held for a few months.

It is understood that local parties will not bid for the stock, but will center efforts in fight against confirmation of any sale by the court at New York.

Automobile Club Sells Home in New York City

NEW YORK, June 25—The clubhouse of the Automobile Club of America at 259 West Fifty-fourth Street, long a landmark in motoring, has been sold. The property consists of a plot 131 x 100 ft. on West Fifty-fourth Street, on which an eight-story building stands, and a plot 91 x 100 on West Fifty-fifth Street, on which a thirteen-story building stands. Real estate operators who purchased the property have not announced their plans.

This sale does not mean the passing of the Automobile Club of America, which was organized in 1899. The location on West Fifty-fourth Street had become so valuable that the club believes it can serve its 5000 members equally as well in more modest quarters, which will be secured in the near future.

The present clubhouse was built in 1906 at a cost of \$600,000, and was regarded as the most magnificent building ever constructed by an American automobile club. Its auditorium has been used many times by the Society of Automotive Engineers for its Metropolitan Section meetings.

Lack of Supervision Blamed for Accidents

Report to Casualty Bureau Recommends That All Operators Be Licensed

NEW YORK, June 26—Holding up Massachusetts, Connecticut and Maryland as good examples of what can be accomplished through strict supervision of motor vehicle operators, William J. Cox, engineer in charge of traffic accident research, has reported to the National Bureau of Casualty and Surety Underwriters, ascribing the failure of most States to exercise any direct supervision over the users of automobiles, or even to make any effort to determine the fitness of persons driving such vehicles, as one of the most important causes of the growing seriousness of the automobile accident problem.

License Laws Vary

As analyzed by Cox, there are thirty-five States requiring the licensing of professional chauffeurs only, fifteen licensing all motor vehicle operators, nine requiring the examination for chauffeur's license only and seven requiring the examination for all operators. In other words, he says, thirty-three of the forty-eight States make no attempt to exercise direct supervision over the great bulk of their highway users, while forty-one States make no attempt to determine the fitness of these citizens to use the highways.

Cox declares that the type of supervision exercised by Connecticut, Maryland and Massachusetts should be the universal rule because of the results attained. He says:

Since 1919, when these laws may be said to have become effective, automobile registration throughout the country at large has increased 63 per cent. In these three States it has increased 58 per cent. During this period automobile fatalities throughout the country have increased 42 per cent. But in these three States they actually have fallen off 2 per cent. Had this latter percentage obtained at large there would have been 9700 automobile deaths in 1922 instead of 14,000.

Control of Drivers Important

For their satisfactory accident record, the administrators of the motor vehicle laws in these States give the largest measure of credit to the control afforded by their power to refuse the issuance of a license or to revoke a license for cause. In the light of the foregoing facts, it is not surprising to find students of traffic practically united in their advocacy of more stringent licensing laws. In a field in which there is a great divergence of opinion upon most subjects, upon this one matter of licensing laws there is practical unanimity.

As Cox sees it, the lack of interest in this subject in so many States is explained by an investigation which shows, he claims, that in most Legislatures the representatives of small towns and rural

districts constitute a majority. Except in a very few States, the accident problem outside the cities has not become sufficiently acute to arouse public sentiment. Although the cities and more congested suburban areas see the need of more careful regulation, this vision does not extend to the rural districts, and accordingly the rural representatives get no demand for action from the people back home.

Cox believes this condition will continue until a fundamentally different attitude toward the operator's license is aroused in the country at large and not merely at points where accidents are numerous. The survey which the National Bureau is conducting to discover some means of measuring more exactly the accident-making potentialities of the individual driver will probably lead, he thinks, to certain changes in the present basis of automobile accident insurance rate-making, with the view of having the cost of insurance a greater accident prevention force than it is today.

Strict Licensing of Cab Drivers

NEW YORK, June 26—A municipal advisory committee, which has been investigating the cause for the commissioner of licenses holding up applications of more than 1000 chauffeurs for permits, has reported, offering rules for the governing of cab drivers.

The committee claims that applications are not scrutinized carefully enough and that criminal records of applicants should be thoroughly investigated, no licenses being granted to those who have been convicted within three years from the time of application of a misdemeanor, unless the sentence has been suspended.

Drivers refusing to take passengers because the distance is short or are guilty of discourtesy, profanity, overcharging or any other abuse should have their licenses either suspended or revoked.

South Beloit Foundries Operated by Wanner

BELOIT, WIS., June 25—Operation of the South Beloit foundries, recently sold by the Stewart-Warner interests to the Wanner Malleable Iron Co. of Hammond, Ind., has been started with 125 men. Immediate orders include one for 50,000 front wheel hubs for Ford and others for small malleable parts for Chevrolet and Studebaker.

Harold Hemenway, for five years vice-president and general manager of the Peoria (Ill.) Malleable Castings Co., is in charge of the Beloit plant as general manager. A large steel furnace in the works is being dismantled to make room for an additional malleable furnace and more annealing ovens. When the replacement is completed about Aug. 1, the force will be doubled in numbers.

FORD'S WEEKLY OUTPUT

DETROIT, June 28—Ford Motor Co.'s output of cars and trucks for domestic use in the week ending June 26 was 40,197. Tractor production was 1115 and Lincoln car output 191.

Truck Owners Plan to Educate Drivers

Take Definite Steps at Convention of Association—Needs for Education Expressed

MILWAUKEE, June 28—Definite steps to provide facilities for educating drivers of motor trucks, recognized as one of the greatest needs of the motor transport industry, were taken at the closing session of the annual convention of the National Team and Truck Owners' Association Wednesday.

David Beecroft, of the Glass Journal Co., in an address on "The Human Element," pointed out that motor trucks have developed much faster than the driver, and the work of the best engineers living is, to a large extent, wasted because men who might make excellent horsemen are almost hopeless in properly driving and caring for motor vehicles.

National plans for co-ordinating rail, water and trucking transportation were explained by S. Maher Brainerd Taylor of Washington. Taylor exhibited drafts of new plans providing terminals beyond congested districts to be served by motor truck. Closer cooperation among motor transport companies to eliminate fly-by-night operators who cut haulage rates by unsound business methods and elimination of exorbitant taxes that feed on the industry were stressed.

Trucks Serving Railways

A keynote of the convention was the repeated evidence of the acceptance of motor trucks by the railroads of America as a hand-maiden to steam service, and the disappearance of the former feeling that the motor truck was a competitor to be feared.

J. X. Galvin of Chicago, who was re-elected president, sponsored the cause of the horse as ideal for short hauls, especially in congested districts, and insisted horsedrawn vehicles will never be supplanted entirely in this use. Galvin advocated laws to regulate loading and providing horizontal speed limit of twelve m. p. h. for all freight transportation vehicles. One and one-half ton trucks, carrying three-ton loads and running 18 to 25 m. p. h., are responsible for the attitude of legislatures, he said.

E. F. Moreton of Detroit, and J. W. Glenn of Buffalo were re-elected vice-presidents; F. F. Tirre of St. Louis, secretary, and William McDevitt of Cincinnati, treasurer.

FRANKLIN 21 YEARS OLD

SYRACUSE, June 27—July will be the anniversary month for the Franklin Automobile Co., which will celebrate its twenty-first birthday. Dealer celebrations will be held and an effort made to ascertain the longest record of continuous ownership in each State, the oldest Franklin still in operation and the Franklin with the oldest mileage record.

Parts Makers Report Collections Improved

**M. A. M. A. Members Show 38
Per Cent Decrease in Notes
Outstanding in May**

NEW YORK, June 29—May sales of members of the Motor and Accessory Manufacturers Association totaled \$58,409,550. While this shows a decrease of 5.25 per cent over April, which was a record month in the equipment field, yet it is on a par with March and about \$15,000,000 better than May of last year. This slight decline might be expected at this time of the year anyway, so parts people look upon it as seasonal and continue to be confident of business holding up well throughout the summer.

The status of the industry is well illustrated by the returns showing that notes outstanding amount to only \$1,140,150, which is a decrease of 38 per cent over April, and the best mark in this particular that ever has been shown. Past due notes also are in remarkably fine shape, for the \$1,982,750 outstanding represents a decrease of 14.28 per cent over April.

Parts makers continue to report optimistically on the immediate future. Their plants are operating at high speed, and even the conservative makers do not hesitate to predict a continuance of good business for some little time to come.

A New York man of the industry who has just returned from a business trip through the West that brought him into close contact with parts manufacturers brings back reports that seem to bear out such expectations. He states that some of the equipment concerns have commitments running into August and September. No cancellations of contracts are being received from automobile manufacturers, and there are no holdup orders, he reports. In a few cases there have been reductions in commitments, but these are confined to not more than four or five companies. Collections are excellent everywhere.

Truck Gains Shown in Parts Activity

(Continued from page 1438)

Demand continues spotty, with some buying areas still showing a falling off from previous demand. Some of the better-known makes in closed car models are slow of delivery, due chiefly to time necessary to turn out this type of automobile. Rail transportation facilities are reported to be adequate, with sufficient equipment available to meet all immediate needs. Boat shipments have taken some of the burden off the railroads, this relief being made possible through increased accommodation offered for shipping by waterways.

Business Transacted by M. A. M. A. Members in May Aggregated \$58,409,550

NEW YORK, June 27—Reports from members of the Motor and Accessory Manufacturers Association show that sales in May decreased 5.25 per cent over the preceding month. Total purchases amounted to \$58,409,550.

The following table shows the sales by members of the association, the total past due accounts and the totals of notes held for all of 1922 and the first five months of 1923:

	Total Sales	Per Cent Change	Total Past Due	Per Cent Change	Total Notes Outstanding	Per Cent Change
1922						
January ...	\$17,320,000	20.61 Inc.	\$4,450,000	5.45 Inc.	\$3,146,000	7.02 Dec.
February ...	22,720,000	31.17 Inc.	4,070,000	8.57 Dec.	3,483,000	10.74 Inc.
March	28,670,000	26.14 Inc.	2,890,000	28.86 Dec.	2,657,000	23.69 Dec.
April	33,830,000	18.70 Inc.	3,000,000	2.00 Inc.	2,500,000	1.05 Dec.
May	43,700,000	28.06 Inc.	2,900,000	2.75 Dec.	2,450,000	6.05 Dec.
June	42,000,000	3.85 Dec.	2,840,000	1.25 Dec.	2,320,000	5.00 Dec.
July	41,001,670	2.42 Dec.	3,423,850	20.42 Inc.	2,217,670	4.49 Dec.
August	43,700,000	5.00 Inc.	3,705,000	8.21 Inc.	2,398,350	8.15 Inc.
September..	37,300,050	13.36 Dec.	4,220,400	13.91 Inc.	2,658,800	10.86 Inc.
October ...	39,753,800	3.90 Inc.	3,463,850	17.93 Dec.	2,603,100	2.09 Dec.
November..	36,616,850	5.51 Dec.	4,245,850	22.58 Inc.	2,442,700	6.15 Dec.
December..	34,711,630	5.20 Dec.	3,494,850	17.69 Dec.	1,905,650	21.98 Dec.
1923						
January ...	45,451,950	30.94 Inc.	2,469,950	29.33 Dec.	1,945,850	2.11 Inc.
February ...	48,518,700	6.75 Inc.	2,741,100	10.82 Inc.	1,981,950	1.86 Inc.
March	59,428,800	22.49 Inc.	2,129,350	22.32 Dec.	1,929,370	2.66 Dec.
April	61,647,050	4.00 Inc.	2,313,150	8.05 Inc.	1,839,350	5.00 Dec.
May	58,409,550	5.25 Dec.	1,982,750	14.28 Dec.	1,140,150	38.00 Dec.

In some distributing centers there is a slight stocking up of cars, which is engaging the attention of producers. Manufacturers declare that output is being governed solely by retail demand and that schedules will be curtailed immediately upon evidence that a let-up in the buying movement has become general. At present there is evident a trend toward shifting stocks from districts where there is a decline to sections promising a heavier demand.

Government Will Start Rubber Study in Brazil

WASHINGTON, June 26—Dr. Carl D. La Rue, Dr. James R. Weir, E. L. Prizer and M. K. Jessup of the Bureau of Plant Industry, United States Department of Agriculture, expect to sail for Brazil shortly after July 1 to undertake a biological study of rubber plants in different regions in the Amazon Valley. Dr. C. F. Marbut of the Bureau of Soils will accompany the party for the purpose of making a study of the soils of this region in reference to rubber production.

The investigation is made possible through funds provided by Congress for that purpose.

SHORTAGE OF MATERIALS FELT

SPRINGFIELD, OHIO, June 26—Because of its difficulty in getting materials, the Kelly-Springfield Motor Truck Co. has discontinued its night shift, according to General Manager Pearl A. Lewis. Despite this difficulty, production at the plant has been kept up and is now equal to that of any time this year, he says.

Used Car in Boston Makes \$50.81 Profit

BOSTON, June 25—Boston dealers made a profit of \$50.81 per car on the 2002 used cars handled by them in the three months from March to June, according to a report of General Manager J. W. Bowman of the Used Car Statistical Bureau. This is a surprising showing as compared with the period previous to June, 1922, when the average profit, after reconditioning, was only \$5.35.

The figures quoted by Bowman show that on the 2202 used cars the total allowance was \$1,470,187. The dealers spent \$84,044 in reconditioning the cars, bringing their investment up to \$1,554,231. They sold the cars for \$1,666,112, leaving an excess for overhead selling of \$111,881.

Average Allowance \$667.66

The average sale price per car was \$756.64, while the allowance price per car, less repairs, was \$667.66. Repairs cost \$38.17, bringing the total cost per car up to \$705.83.

Bowman sounds a warning to the dealers by pointing out that the three best months of the year for selling used cars closed May 31.

He says:

Our tabulations to the first of June show a large increase in volume of sales, which is quite in order. This month should show as good results, but from July 1 you must be more careful in your second hand dealings. Remember that on Aug. 1 some of the manufacturers bring out new models to compete with the 1923 and in 1924 there will be many new features that will appeal to the public very strongly.

The older models will not be sought for and in consequence the prices must drop in order to move used car stocks.

12,500 Cars Shipped Abroad Last Month

This Figure Does Not Include
Canadian Shipments, Which
Reached 3427

WASHINGTON, June 26—The exports of automobiles from this country continued during May at approximately the same high levels that marked earlier months of the year. The monthly statistics covering shipments from the United States, made public today by the Bureau of Foreign and Domestic Commerce, place the May shipments at 12,500 passenger cars, 2605 motor trucks, unit assemblies, valued at \$1,350,248, and parts and accessories, not including engines and tires, at \$4,208,377.

The shipments from the United States

during May represented a small decline in passenger cars, compared with April.

In the statement made public, the shipments from this country during the eleven months ending May 31 are shown to have been 104,766 units, an expansion of 250 per cent over the same period ending May 31 of last year.

Canadian Exports

Passenger car exports from Canada for May totaled 3427, with a value of \$1,893,211, as compared with 2562 of a value of \$1,498,276 in May, 1922. Trucks exported last month were 790, valued at \$274,241, compared with 251 of a value of \$112,156 in May a year ago.

For the twelve months car shipments were 48,090, valued at \$26,837,865, as against 17,735 of a value of \$9,998,196 for the preceding twelve months. Truck shipments for that period were 4765 contrasted with 1526.

Parts were exported in May to the value of \$368,335 compared with \$117,870 in May a year ago.

Industry Increased Employment in May

Last Month Plants Employed
259,041 Men As Against
255,463 in April

WASHINGTON, June 23—An increase of 1.4 per cent in the number of workers engaged by 174 automobile manufacturers in May over the previous month is noted in the regular monthly survey of the United States Department of Labor. The figures show that during May the 174 companies reported 259,041 employees, as compared with 255,463 in April. The amount of the payroll for the last week in May compared with that covering the last week in April show an increase of 1.8 per cent.

Reports from seventy-one automobile
(Continued on page 1449)

Exports, Imports and Reimports of the Automotive Industry for May of Current Year and the Totals Reported for the Last Eleven Months

	Month of May				Eleven Months Ending May 31			
	1922		1923		1922		1923	
	No.	Value	No.	Value	No.	Value	No.	Value
EXPORTS								
Automobiles, including chassis.....	8,027	\$5,763,539	15,121	\$9,795,725	43,358	\$36,246,651	104,766	\$73,710,883
Electric trucks and passenger cars.....	26	27,235	16	25,044b	120b	174,561	272	359,454
Motor trucks and buses, except electric (d) ..	.....	.....	.....	.....a	2,727a	2,851,223	.....	.....
Up to 1-ton.....	939	319,536	2,175	687,320b	2,522b	1,086,850	12,414	4,470,794
Over 1 and up to 2½-ton.....	180	272,468	367	411,662b	806b	1,172,010	3,096	3,687,656
Over 2½-ton.....	84	220,166	63	137,434b	252b	626,455	681	1,832,300
Total motor trucks and buses, except electric	1,203	812,170	2,605	1,236,416	6,307	5,736,538	16,191	9,990,750
PASSENGER CARS								
Passenger cars, except electric (d).....	.....	.....	.....	.....a	13,708a	12,164,579	.....	.....
Value up to \$500 (inclusive).....	.....	.....	6,115	2,245,117	.....	.....b	22,834b	7,907,186
Value over \$500 up to \$800.....	4,529	2,098,907	2,269	1,526,966b	14,348b	6,847,061	34,695	19,223,888
Value over \$800 up to \$2,000.....	2,096	2,311,407	3,846	4,030,908b	8,139b	9,002,775	28,608	30,279,758
Value over \$2,000.....	173	513,820	270	731,274b	736b	2,321,137	2,166	5,949,847
Total passenger cars, except electric (d)...	6,798	4,924,134	12,500	8,534,265	26,931	30,335,552	88,303	63,360,679
PARTS, ETC.								
Parts, except engines and tires*.....	13,294,265	3,160,448	.....	.....	.....	29,831,965c	79,316,512c	18,618,812
Automobile unit assemblies*.....	.....	.....	9,351,791	1,350,248	.....	.....b	14,918,175b	2,295,316
Accessories, parts of*.....	.....	.....	15,601,479	4,208,377	.....	.....b	101,122,669b	22,680,386
Automobile service appliances*.....	.....	.....	125,845	80,854	.....	.....b	437,801b	250,422
Station and warehouse motor trucks (No.) ..	42	29,970	24	7,116	141	150,846	131	80,187
Trailers.....	34	6,149	90	55,489b	233b	104,035	832	335,587
Airplanes.....	1	2,230	1	300	43	150,995	34	351,030
Parts of airplanes, except engines and tires*	15,228	11,202	1,277	960	.....	84,198	428,634	232,451
BICYCLES, ETC.								
Bicycles and tricycles (No.).....	812	14,334	4,137	22,414	.....	468,978	22,045	168,038
Motor cycles.....	1,695	453,495	1,859	445,223	9,539	2,574,511	17,775	4,186,354
Parts, except tires.....	336,016	197,951	321,953	151,338b	1,400,038b	758,725	2,614,087	1,364,798
INTERNAL COMBUSTION ENGINES								
Stationary and Portable Engines—								
Diesel and semi-Diesel.....	1	7,816	359	130,976b	49b	39,161	920	406,664
Other stationary and portable.....	1,932	203,213	.....	.....	15,011	2,284,373c	14,729c	1,781,589
Not over 8 hp.....	.....	.....	2,968	255,265	.....	.....b	11,342b	890,648
Over 8 hp.....	.....	.....	113	72,251	.....	.....b	643b	377,513
Automobile engines.....	5,590	616,128	.....	.....	24,750	3,124,168c	15,619c	1,910,857
For motor trucks and buses.....	.....	.....	1,188	134,932	.....	.....b	2,235b	263,857
For passenger cars.....	.....	.....	5,566	744,946	.....	.....b	21,396b	2,551,510
Engines for tractors.....	.....	.....	611	108,514	.....	.....b	699b	147,016
Engines for aircraft.....	29	8,229	1	250b	63b	29,329	70	38,902
Engine accessories and parts for*.....	509,802	234,295	616,422	270,611b	2,834,359b	1,116,771	6,292,169	2,675,257
All other engines and parts of.....	.....	.....	.....	.....b	.....a	3,940,067	.....	.....
IMPORTS								
Automobiles and chassis (dutiable).....	34	79,105	61	73,062	417	717,613	508	801,853
Other vehicles and parts.....	.....	80,607	.....	272,831	.....	818,600	.....	1,171,703
REIMPORTS								
Amount of duty collected.....	.....	.....	.....	.....	.....	.....	.....	208,152
Automobiles free of duty.....	172	357,140	84	83,738	2,641	4,154,032	3,162	3,834,679

a—July 1 to Dec. 31, 1921. b—Jan. 1 to May 31. c—July 1 to Dec. 31, 1922. d—Includes electric prior to Jan. 1, 1922.
* Pounds.

Durant Builds Flint in Limited Numbers

Now That Production Has Started,
Daily Schedules Will
Be Increased

NEW YORK, June 25—Durant Motors, Inc., is in production on the Flint, the \$1,195 car that belongs to the Locomobile unit. Manufacture of these cars is going on at the Long Island City plant pending the completion of the factory at Flint, Mich. At present the Flints are being turned out in limited numbers, but now that actual production has started, it is expected that the daily schedule will be increased. The plant at Flint is rapidly nearing completion, and it is hoped that it will be ready for occupancy within the next month.

Great activity continues to mark Durant progress. On June 19 the organization celebrated the completion of its 100,000th car since Jan. 1. Of this total 73,000 were Stars and the remaining 27,000 Durants.

The corporation is planning additional manufacturing capacity for the Durant plants at Lansing and Oakland, and a new plant is in prospect for the Mason truck at Flint. This factory will be built adjoining the plants of the Flint and Star on the Dixie Highway, in accordance with a decision arrived at following the May record when Mason nearly doubled its output over any previous month.

Another Durant subsidiary, the Hayes-Hunt Corp., is building bodies at the rate of 10,000 a month at Elizabeth, employing 800 men. In addition to operations at Flint, Durant is preparing to start operations immediately at Lansing, Flint and Oakland. At Oakland Hayes-Hunt will have an output of from 48,000 to 60,000 bodies annually, while larger outputs will be necessary at both Lansing and Flint, the former requiring 550 bodies daily.

Doble Steam Car Starts Work on Oakland Plant

OAKLAND, CAL., June 25—Ground has been broken at Emeryville, a suburb of Oakland, for the plant to be erected by the Doble Steam Motor Car Corp. The first unit is expected to be on a production basis by Nov. 1, and the completed plant will cover two and one-half acres, with a building five stories in height. The manufacturing area is to be 361,000 sq. ft. and the office area 41,300 sq. ft. Total cost of the plant is estimated at \$900,000.

Mayor John L. Davie of Oakland turned the first spadeful of earth, and the ground-breaking exercises were made the occasion of a joint celebration by the Oakland Chamber of Commerce and the Emeryville Industrial Association. These exercises started with a luncheon in the Hotel Oakland, with Abner Do-

DEMONSTRATION FARM FOR SOUTHERN TRADE

ATLANTA, June 26—According to an announcement by the Atlanta office of the International Harvester Co., a large model demonstrating farm has been secured near Montgomery, Ala., by the company, and will be completely equipped with power farming machinery, tractors and motor trucks, to demonstrate by actual work the real worth of modern equipment to the average farmer.

The farm contains more than 150 acres and will be almost completely operated by machinery. It is the company's first demonstration farm in the South, though it operates two such farms in the North.

ble, inventor of the Doble Steam Car and president of the company, as the guest of honor.

After the luncheon a parade was held in which appeared duplications of five of the early models of steam automobiles and of present models of the Doble car.

Government Makes Claim Against Former Premier

INDIANAPOLIS, June 23—United States District Attorney Homer Elliot has served notice that four Government claims for overpayment on war time cost plus contracts will be filed in Circuit Court here against the Fletcher Savings & Trust Co. as receiver for the Premier Motor Corp. It is said that the Government claims will not affect the assets of the Premier corporation, which were sold to Frederic I. Barrows and transferred in the name of the Western Bond & Investment Co., of which Barrows is president, as he is of the newly organized Premier Motors, Inc.

The notice filed by Elliot requests the court to order the receiver to show cause why it, as receiver, should not hold in escrow until the Government claims are satisfied such money as is held by the receiver after the payment of all claims of priority.

A similar request is also made regarding the 25,000 shares of Premier stock set aside at the time of reorganization for distribution to the general creditors of the Premier Motor Corp. The suit regarding the claims will probably not be heard until September.

BRUSSELS SHOW IN DECEMBER

PARIS, June 15 (by mail)—Brussels will hold its automobile show from Dec. 8 to 19, this being about one month earlier than the usual date. In addition to passenger cars and trucks, it has been decided to include an aviation section and a motor boat division. The show will be held in the Aviation Palace, a new building replacing the Palais du Cinquentaire.

Developing New Car Costly for Mitchell

Blamed for Failure of Company
—Liabilities Reported as
Being \$4,000,000

RACINE, WIS., June 25—Development and pioneering of an entirely new model was described as the expensive procedure to which the failure of the Mitchell Motors Co., Inc., of Racine, Wis., is attributed, according to testimony adduced at hearings being held by Referee Milton Knoblock with the cooperation of the trustee, Herbert F. Johnson, and attorneys for creditors.

The Mitchell company reported liabilities of approximately \$4,000,000. Officers of the bankrupt concern said the overhead expense and sale of a new model at much less than actual production cost resulted in a financial condition which it was found impossible to overcome.

Loans to Subsidiary

B. F. Armstrong, secretary, said that for several years the operation had been at a heavy loss. He said that the New York-Mitchell Co., a subsidiary, had been declared bankrupt and that it owed the parent company \$500,000. The stock in the New York company was owned by the Racine factory. The fact that such large credit had been extended, and this indebtedness apparently had been created within two years' time, resulted in a demand that the books of the New York company be brought to Racine for examination by the trustee and attorneys for creditors.

Tax liens aggregating \$218,248 have been filed against the Mitchell company by the collector of internal revenue at Milwaukee. The claims, which are to take precedence over other creditors are: Income tax for 1919, \$148,253; 12 per cent penalty, \$14,887, and interest, \$336; manufacturers' excise tax, February, 1919, to November, 1922, \$63; to March, 1923, \$2,552, and income tax, 1917, \$52,127.

Ford's 5 Months Sales in U. S. Reach 732,850

DETROIT, June 23—Sales of Ford cars and trucks in the United States for the first five months of the year were 732,850, an increase of 322,005 over the same months a year ago. Sales will pass the million mark in July, at the present rate of demand, a figure which would have been reached at this time had it been possible to bring production up to orders.

In the week ending June 19 a new weekly high mark was established with 40,375 cars and trucks for domestic use, twenty-nine more than built in the week previous. The daily high mark was set at 6,817 on June 13. Fordson tractor production for the week was 2428, and Lincoln cars built totaled 171.

Men of the Industry and What They Are Doing

Swayne Sails for Six Weeks' Trip

Alfred H. Swayne, vice-president of the General Motors Corp., sailed Saturday on the Majestic for a six weeks' business trip abroad. He will visit London, Paris and Copenhagen in the interests of the corporation's overseas activities.

Pyke Johnson Returns from Spain

Pyke Johnson, who represented the National Automobile Chamber of Commerce at the international road conference held at Seville, has returned home.

McEvoy Shifting Headquarters

James McEvoy, chief of the patent department of General Motors, is transferring his headquarters from Detroit to Dayton, where he is establishing offices in the laboratories of the General Motors Research Corp. L. M. Spencer and G. L. Lovett of the same department also will transfer to Dayton. This move is interpreted as a denial of the rumor that General Motors might give up the Dayton laboratories. The patent department will maintain an office and staff in Detroit as well as the new headquarters in Dayton.

Wants Auten to Manage City

James E. Auten, member of the executive staff of the LaFayette Motors Corp., Milwaukee, has been offered the position of city manager of Janesville, Wis., at a salary of \$8,000 annually. He was selected from forty experts proposed for the position, which is a new one. Auten has been given until July 2 to accept, but has not intimated what his decision will be. He was one of the directing heads of the Samson Tractor Co. at Janesville, Wis., until General Motors converted this interest into a Chevrolet and Fisher body division.

Guests on Leviathan

Representative of the automotive industry on the trial trip of the Leviathan were A. R. Erskine, president of the Studebaker Corp.; F. E. Moscovics, vice-president of the Nordyke & Marmon Co.; Ray M. Owen, president of the Owen Dyneto Co. of Syracuse, and Harry T. Hollingshead, Chicago Nash dealer.

Dr. Burgess Long in Standards Work

Dr. George K. Burgess, the new director of the Bureau of Standards at Washington, has been identified with that department of the Government since 1903, being chief of the Division of Metallurgy prior to succeeding Dr. S. W. Stratton. Dr. Burgess is president of the American Society for Testing Metals, is the author of 100 books on scientific works and is a graduate of the Massachusetts Institute of Technology and the University of Paris. Prior to his affilia-

tion with the bureau he taught in the University of California and University of Michigan.

Fafnir Advances Cox

M. Howard Cox, for nine years Detroit representative of the Fafnir Bearings Co. of New Britain, has been appointed sales manager of the automotive division of that company.

O'Brien Assists Apperson President

J. H. O'Brien has been named as assistant to the president of the Apperson Brothers Automobile Co., Kokomo, Ind. O'Brien started with the Ford Motor Co. ninety days after it was organized and was buyer for six years. Then he joined Regal, following which he was identified with Lozier for three years, leaving to take charge of purchases for the Nordyke & Marmon Co. After four years service there he became associated with the Cole Motor Car Co., where he officiated in the same capacity he now holds at Apperson.

Brouse American Rubber Sales Head

Richard W. Brouse has been made sales manager of the Akron Rubber & Tire Co. of Akron. He has had fourteen years' experience in various phases of the rubber industry with the B. F. Goodrich Co. Brouse comes to his new position from Cleveland, where he was Goodrich manufacturer's sales representative for the Eastern district.

Nelson Succeeds Hemenway

Gus Nelson, for thirty years associated with the Borg & Beck plant in Moline, Ill., has been appointed works manager of the Moline Foundry Co. He succeeds Harold Hemenway who was recently made general manager of the Wanner plant in Beloit, Wis.

Kohler Again Heads Regents

Walter J. Kohler, president of the Kohler Co. of Kohler, Wis., manufacturer of electro-generating units for farms, has been reelected chairman of the board of regents of the University of Wisconsin, Madison, for a third term.

Murray Goes to Spain for Ford

Samuel Murray, formerly branch manager of the Atlanta plant of the Ford Motor Co., has been named branch manager of the Ford Motor Co. branch at Barcelona, Spain, and leaves New York the latter part of June to take up his new post.

G. J. Lux Resigns

G. J. Lux has resigned as chief engineer of the Detroit Gear & Machine Co., Detroit. His plans for the future are not announced.

Ford Proposes Plan to Use Coal Twice

Will Conduct Experiment in Canada to Obtain Motor Fuel as By-Product

DETROIT, June 27—Ford Motor Co. of Canada is proposing to make the experiment of extracting a motor fuel from coal which, if successful, will result in the placing upon the Canadian market of 4000 gal. daily as a starter. There is no intimation of how far the work might be carried if the fuel and the method of its extraction prove successful, the 4000 daily quantity being fixed as the amount yielded as a by-product from the 400 tons of coal used daily in the Canadian plant.

The fuel differs from the benzol extracted at the Ford River Rouge plant as a by-product of coke, which is now being sold at many points in this city. The new fuel is an extraction from coal by a low temperature process, equipment for which is now being built into a special plant at the new Canadian factories of the Ford company. Following distillation the coal is reported to remain unimpaired as a heat producer.

In making the experiment Wallace R. Campbell, vice-president and general manager of the Canadian Ford Co., said the company had no plans at this time to produce the fuel in quantities in excess of that yielded from the daily coal tonnage required at the plant.

This would be placed upon the Canadian market for trial by motorists. It is expected that the new fuel will be lower in price than gasoline, although production costs are yet unknown.

Introduction of the fuel into the United States, it is indicated, will hinge upon the result of the Canadian experiment.

Roller-Smith Appoints Baker

H. D. Baker has been appointed Michigan representative of the Roller-Smith Co., of New York City, maker of electrical instruments and circuit breakers. His headquarters will be 525 Woodward Avenue, Detroit.

Moore Joins Agency Staff

Donald E. Moore, formerly secretary-treasurer of the Traub Manufacturing Co., has joined the staff of the Campbell-Ewald Co., Detroit.

Casey Heads Cleveland Office

Matthew J. Casey has been placed in charge of the Cleveland office of MacManus, Inc., which handles many automobile advertising accounts. The company has taken larger offices in the Keith building.

Hudson Car Prices Reduced \$50 to \$75

Company Says Greatly Increased Output and Good Outlook Warrant Action

DETROIT, June 22—Price reductions ranging from \$50 to \$100, made by the Hudson Motor Car Co. on its Hudson models, come at a time when company production is twice as high as it was when the last price cut was made. In making the announcement, the company declares the reduction is warranted by the greatly increased output and by the prospect of continued capacity operation.

The new prices place the four-passenger phaeton at \$1,375, the seven-passenger phaeton at \$1,425, the coach at \$1,450, and the sedan at \$1,995. The sedan has been changed from a seven-passenger to a five-passenger model.

Irrespective of the effect of the price cut, the company declares that June business will run in excess of May, which was the highest month in the history of the company. July is expected to equal June. The company is far oversold, it reports, and has business on its books several months ahead. Sales at retail about the country are far in excess of former years, it is reported, and dealer stocks are at a minimum.

Lafayette Lists Higher; Increase Reaches \$1,115

MILWAUKEE, July 1—Effective July 1, the Lafayette Motors Corp. announces the following increases in prices:

	Old Price	New Price
Chassis		\$4,200
Roadster	\$3,985	5,000
Phaeton	4,090	5,000
Torpedo	4,090	5,000
Four-Door Coupe	5,500	6,300
Imperial Limousine	5,750	6,750
Sedan	5,500	6,500
Limousine	5,500	6,500

Demand for New Packard Reported Running Strong

DETROIT, June 27—Reports received by the Packard Motor Car Co. from distributors and dealers about the public interest in the single eight model leads to the declaration by the factory that it does not expect any sales problem on this model within two years. The problem will be entirely one of distribution for many months, the company declares, and a considerable time will be required alone in getting out 1500 cars as demonstrators.

Production on the new model thus far is limited, and it will be some time before a regular daily output will be acquired. The company is in the position, it says, in which every single six it can build is required, and it has to build the single eight in addition to this heavy demand. It is impossible at this time

to declare how the production run will be divided between the two classes, but the single six will continue to be the big volume car of the company.

All single eights now being built are being driven away by distributors, dealers or representatives. In working out the distribution of the car, the company declares it will first supply its sales organization with models and then will follow its regular distribution method.

Light Six Studebaker 1923 Model, Now Ready

NEW YORK, June 27—Models of the 1923 Light Six Studebaker are now ready for delivery to dealers and show a number of constructional changes, principally in the engine. The crankshaft in the new models has four bearings instead of three and four piston rings are used per piston instead of three. The manifold has been changed and now resembles the design used on the Special Six.

The distributor base and stand have undergone some changes and the cylinder head is a new design. It is now possible to regulate the hot air supply to the carburetor to conform to air temperature changes. A number of minor changes have been made in the body.

No changes have been made in the Special and Big Six and all prices remain as before.

Jordan Issues First List Setting Used Car Prices

CHICAGO, June 25—Used Jordan cars which have been reconditioned according to the requirements of the Jordan company, entitling them to be marked with the "Mark of Jordan Service," are now being offered for sale at prices designated by the factory and widely advertised. The following price list has been authorized for such cars, f.o.b. Chicago:

1920 Model M Phaeton	\$ 900
1920 Model M Play Boy	900
1920 Model M Brougham	1,200
1920 Model M Sedan	1,200
1921 Model M Touring	1,100
1921 Model M Play Boy	1,100
1921 Model M Brougham	1,400
1921 Model M Sedan	1,400
1921 Model F Phaeton	900
1921 Model F Sedan	1,400
1922 Model F Phaeton	1,300
1922 Model F Sedan	1,650
1922 Model MX Phaeton	1,400
1922 Model MX Play Boy	1,450
1922 Model MX Brougham	1,650
1922 Model MX Sedan	1,700

Prices of Ruggles Truck Will Be Increased July 1

SAGINAW, MICH., June 25—Announcement is made by the Ruggles Motor Truck Co. of an increase in prices effective July 1. The new list follows:

	Old Price	New Price
Model 15, 3/4-ton	\$ 795	\$ 895
Model 20-R, 1 1/4-ton	1,295	1,375
Model 40, 2-ton	1,995	2,095
Model 40-H, 2 1/2-ton	2,195	2,295

More Tire Producers Make Cuts in Prices

Movement Started by Firestone Finds Followers Among Other Companies

NEW YORK, June 25—As was predicted at the time the Firestone Tire & Rubber Co. announced its reduction in tire prices, other big companies have followed suit within the past week.

The United States Rubber Co. has lowered its lists 10 per cent on plain fabrics, Usco fabrics and nobby fabrics as well as on the Royal cord; and 4 per cent on clincher cords. Solid tires have gone back to the prices effective Jan. 2, 1923, with the exception of the Mono, which stands 5 per cent over the January list. Tubes have gone back to the Jan. 2 list. With the 6, 7 and 8 in. size, pneumatic nobby tread truck cord there has been no change, while on the 4 1/2 and 5 there has been a cut of about 10 per cent.

The B. F. Goodrich Co. has made changes identical with the United States.

Goodyear Tire & Rubber Co. has reduced its straight side all weather cords 13 1/2 per cent to dealers and consumers, while on the Winged Foot straight side it has cut 13 1/2 to the consumer and 18 to the dealer. All clinchers have been lowered from 6 to 13 per cent.

Favors Tax-Free Rubber

Pennsylvania Rubber Co.'s cut has been from 5 to 15 per cent. Accompanying the new list, the company has issued a statement declaring that it believes America should have tax-free rubber, and in order to help the movement it has started a research to develop such rubber.

The General Tire & Rubber Co. has notified dealers that prices on tires and tubes revert to the Jan. 20 list, annulling increases of approximately 10 per cent made in March.

The Lee Tire & Rubber Co. has discontinued its consumers' list, leaving the dealers' list about the same.

So far Kelly-Springfield Tire Co. has not announced a reduction on cords, but it has revised prices on its fabric lines to meet cuts made by other concerns.

Fisk Rubber Co. has decreased prices, the range being from 9 to 11 per cent, according to size.

Firestone Issues New List

NEW YORK, June 28—Firestone Tire & Rubber Co. has issued a new list effective June 25 which brings the prices on some of its tire sizes down to the Aug. 22 list. This meets the greater reductions made previously by other makers.

MITCHELL SALE AUG. 15

RACINE, WIS., June 26—The plant of the Mitchell Motors Co., now in the hands of a receiver, will be offered for sale on Aug. 15.

Parts Makers Report Continued Bookings

Business Keeping Up in Surprising Fashion—Truck Schedules Increase

MILWAUKEE, June 25—Save for the inroads made by vacations and the turnover of labor by competitive bidding for the short supply, production in Milwaukee automotive plants is ranging at about the peak level of the year. In many instances shops are releasing employees for annual vacations by small groups rather than as a whole, in order to sustain production and keep deliveries as close to specifications as possible.

New business for delivery after July 1 is being booked in a steady way by makers of automotive parts and equipment. Most plants expect to be kept busy at capacity until at least Aug. 15 or Sept. 1, judging by the way new orders have been developing during June. It is, of course, unreasonable to expect the pressure of demand experienced during the first six months to continue indefinitely, yet the manner in which business has been sustained thus far has been a surprise to all.

Judging by the increased production schedules of motor truck factories here, and the heavier specifications received by makers of engines, frames and other units, parts and equipment, a prolongation of the upward curve of truck trade is in sight. It is felt here that the advancement of truck output will continue after passenger cars enter the customary downward curve as winter approaches.

Retail Business Good

Despite the fact that factories are delivering cars to distributors and dealers in the Milwaukee territory at a rate hitherto unknown, authentic reports are to the effect that merchandise is not backing up on dealers, whose business so far in June has been such as to absorb even these record-breaking deliveries. Some dealers even report unfilled orders for phaeton and roadster types, although these are almost entirely of the de luxe models, which have not been coming through in the same quantity as the standard open styles.

As a rule dealers here are able to make deliveries at the time of purchase on open cars, while purchasers still find it necessary to wait anywhere from one week to sixty days for closed models. Midsummer weather during most of the past week visibly affected sales favorably.

SEARS CREDITORS TO BE PAID

DAVENPORT, IOWA, June 23—Personal property of the bankrupt Sears Tire Equipment Co., which brought \$2,303, will be distributed among creditors at a final meeting before Referee F. A. Cooper, June 29. An assignment

INSPECTS FIAT PLANT WITHOUT LEAVING CAR

TURIN, June 19 (by mail)—The King of Italy, visiting the Fiat plant, drove through the works without getting out of his car, which is a most unusual stunt. The four cars comprising the royal cortege entered the ground floor where the machine shops are located and were driven through on an inspection tour.

Elevators carried the party, still in the cars, to the second, then to the third, fourth and fifth floors. Work was carried on under normal conditions while the King watched the employees at work.

The tour wound up with the royal party ascending to the roof track, where all Fiat chassis are tested. Here the Fiat racing cars gave a demonstration of speed which interested the King, while at the same time a squad of Fiat airplanes hovered overhead.

by R. B. Altenberg to the Fidelity & Deposit Co. of Maryland of a judgment of \$1,335 has been filed against the Sears company in a replevin suit, begun by the bankrupt company before the bankruptcy proceedings started.

Revised Figures Place May Output at 393,163

WASHINGTON, June 25—Revised figures of the Bureau of the Census on May production of automobiles and motor trucks show 350,180 passenger cars manufactured during that month and 42,983 trucks, a total output of 393,163. The figures shown in the table below cover approximately ninety passenger car and ninety truck manufacturers.

	Passenger Cars	
	1923	1922
January	223,706	81,693
February	254,650	109,171
March	319,638	152,959
April	344,474	197,216
May	350,180	232,431
Total	1,492,648	773,470
	Trucks	
	1923	1922
January	19,398	9,416
February	21,817	13,195
March	34,681	19,761
April	37,527	22,342
May	42,983	23,788
Total	156,406	88,502

OFFERS FORD SITE IN SOUTH

ATLANTA, June 26—The Chamber of Commerce of Gainesville, Ga., dispatched to Henry Ford at Detroit a few days ago a long telegram offering to donate a site of 500 acres near Gainesville for the location of the new cotton mill plant it is reported Ford intends to establish in the South.

M. A. M. A. to Discuss Service-Roads-Taxes

Général Manager M. L. Heminway Preparing for Fall Convention in Boston

NEW YORK, June 25—Following the announcement that the Fall convention of the Motor and Accessory Manufacturers will be held in Boston Sept. 19-21, General Manager M. L. Heminway is making rapid headway in arranging the program.

As at Buffalo last year, there will be general sessions for all executives and other representatives of the 430 affiliated companies of the association and also the two-day conference of credit managers. The Advertising Managers' Council will have a session and in addition there will be meetings of traffic managers and export managers.

General business conditions in the United States and the immediate outlook for the automotive trade will be discussed and there will be an interchange of experiences and viewpoints of various phases of the current situation. Speakers will be drawn from the parts and accessory field, the motor vehicle industry and the ranks of general business executives. Specialized and technical problems will be discussed by experts.

To Take Up Street Planning

On the card for discussion are the automobile service problem, the need for more roads, better street planning and more parking space, and the necessity for combating discriminatory taxation against the automobile industry. In arranging his program, Heminway says that "wise selling strategy must look beyond the immediate present. There are three tremendous problems that constitute serious sales resistance for the automobile industry over the long pull. They are the service problem, the street and road situation and taxation. These are some of the outstanding things which will be discussed at Boston."

Leonard Tractor Director Asks Court for Receiver

JOLIET, ILL., June 23—Wilbur Wynant, a stockholder and director of the Leonard Tractor Co., has filed a petition for the appointment of a receiver and a demand for an accounting of the finances of the corporation in the Will county court.

The liabilities, exclusive of the capital stock, he places at nearly \$145,000, an amount "greatly in excess of the true value of the tangible assets," he says. The company is a Delaware corporation with offices in Joliet and Gary, Ind., but the bill alleges that the only real estate holding is at Griffith, Ind., and the only tractor manufactured was one built for it and used for exhibition purposes.

Rickenbacker Adds 4-Wheel Brake Model

Will Comprise 50 Per Cent of
Production for Present—
Price \$150 Higher

DETROIT, June 27—The Rickenbacker Motor Co. has added a four-wheel brake chassis to its line, which will comprise 50 per cent of the production of the company starting July 1. This schedule will be maintained tentatively for ninety days, after which it will be governed by demand. The four-wheel brake models are identical with the two-wheel brake cars, with the exception of the brake equipment and the changes involved by its installation. The new models will sell for \$150 more than the two-wheel brake cars, which are maintained at their present prices. The same body models are available on both chassis.

The four-wheel brake installation is a development of the system designed for the original Rickenbacker car when it was laid out in 1919. At that time it was decided that it was too early for the introduction of a four-wheel brake system. Realizing, however, the tendency toward such installations, the Rickenbacker company has continually developed its four-wheel brake, and at the last New York show had three models shipped and ready to exhibit when it was decided to delay the announcement until now.

The system is a mechanically operated type employing four internal expanding cam-operated brakes on the four wheels operated simultaneously by the pedal. The hand brake is entirely separate and independent and acts on the forward end of the propeller shaft.

This system of four-wheel brakes, which has been developed by the Rickenbacker company during the last three years, is covered by fifteen patents, which so far have been allowed. These patents cover such features as the elimination of universal joints on the front brake actuating shaft, the shaping of the cam and equalizing block at the front wheel brake in such a way as to reduce the braking effect with the turning of the front wheels and detail of design of the linkage as well as the brake construction.

Industry Increased Employment in May

(Continued from page 1444)

tire manufacturing concerns show a loss of 1.6 per cent in the number of employees in May as compared with April, and a decrease of 3 per cent in the amount of wages paid the last week in May in comparison with the last week in April.

Employment in general during May showed that there was an increase of 0.3 per cent in the number of employees and an increase of 4.1 per cent in the

total amount paid in wages. The figures are based on reports from 6075 representative establishments in forty-seven manufacturing industries, covering 2,259,425 employees.

Bank Reports on Conditions

MILWAUKEE, June 25—The automotive industries and the food industry of Milwaukee are singled out as high lights in the current issue of *Business and Financial Comment*, monthly summary of local conditions issued by the largest local bank. It says:

There was a little slackening of business in Milwaukee during the month of May which was most apparent in the metal trades and in some branches of the textiles. The slackening was felt in orders rather than in plant activity. The food industries and automobiles were not affected.

Employment during the month showed a slight decrease. Textiles, iron and steel, chemicals and the allied products, metal and metal products other than iron and steel reported decreases in payroll numbers. Food products, leather and its finished products, and automobiles reported slight increases. The net result was a decrease of 0.8 per cent for all industries.

The review also says significantly: "Stocks carried by Milwaukee firms appear to have increased, since May, 1922, at a much slower rate than sales and unfilled orders. This indicates a healthy situation and is a vital factor in determining the probabilities for the remainder of the year."

Gain of \$200,000 Shown in Wills' Bank Balance

DETROIT, June 25—Receipts of \$429,711 and disbursements of \$230,318 are shown in the receiver's statement of receipts and disbursements of C. H. Wills & Co. for May. The receiver states that cash on hand and in banks at the beginning of the month totaled \$384,502; the balance at the close of the month was \$583,896.

The statement of assets as of May 24 shows current assets, including inventories, of \$775,432; fixed assets, less taxes, \$3,415,082; deferred charges, \$24,774; total, \$4,215,289.

Hoover Machines Chelsea Factory for New Product

ANN ARBOR, June 25—The Chelsea, Mich., plant of the Hoover Steel Bearings Co. has been machined for the production of high carbon steel balls. The plant has not been in use for some time. The product will be midway in quality between chrome and case hardened balls. They will have the accuracy of high grade steel bearings.

Sixteen Hoffman machines will be installed with a daily capacity of 4,000,000 one-quarter inch balls. The manufacture of chrome balls will be continued at Ann Arbor. It has been found that two types cannot be manufactured successfully in the same plant, because the two materials are constantly getting mixed.

Licensing Officers in West to Organize

Purpose Will Be to Urge Uniform
Laws for Operation of
Motor Vehicles

CHICAGO, June 26—Steps were taken at a meeting here of State officials connected with automobile licensing departments to organize the Western Motor Vehicle Conference for the purpose of bringing about uniformity in laws and regulations governing the operation of motor vehicles.

Representatives were present from Illinois, Iowa, Minnesota, Missouri, Michigan, Wisconsin, Kentucky and some eastern States. Robbins B. Stoeckel, motor vehicle commissioner for Connecticut, explained how uniform laws governing headlights, licenses, weights and highway markings had been brought about in the East. It was the view of those present that in consideration of the large amount of interstate travel by automobile, both the safety and convenience of the automobilists would be greatly increased by uniform regulations.

Fred R. Zimmerman, Secretary of State of Iowa, was elected temporary chairman, and it was decided to hold the next meeting in September at Des Moines, Iowa. This meeting was called at the suggestion of the National Safety Council. David Van Schanck, vice-president of the council, declared that the automobile had obliterated city, county and State boundaries to such an extent that uniform regulations are becoming necessary.

Iowa Starts Movement

DES MOINES, IOWA, June 25—The National Safety Council national program of a uniform law throughout the union requiring every automobile driver to obtain a driver's license and providing other regulations to reduce the dangers of automobile driving will receive its trial in Iowa, for such a bill will be introduced at the special session of the Legislature in December.

William Colladay, head of the motor vehicle department of the State, says that a session of the council will be held here about the time the Legislature meets. State officials have already been assigned various phases of the national law to report at another meeting in September at which it is hoped to start the preliminary draft.

PETROLEUM MOTORS TO START

ROCKFORD, ILL., June 23—Production of the Petroleum Motors Co. engine for truck and other vehicles is scheduled to start about July 1, according to statements made at a luncheon meeting of officials and stockholders. Chester A. Harris, president, and T. G. Jackson, vice-president, said that property and equipment valued at \$130,000 are held free of debt.

BANK CREDITS

Written exclusively for AUTOMOTIVE INDUSTRIES by the Guaranty Trust Co., second largest bank in America.

The general business situation continues irregular. Considerable improvement in the condition of crops, which on the whole gives less than a normal promise, and a slight gain in retail trade are among the favorable developments of the last week. On the other hand, the continued decline in wheat prices is a particularly disturbing factor. The weakness of wheat prices is a reflection not only of the improvement in the outlook for the domestic crop but of the better prospects for producers in competing countries.

No arresting of the recession in average commodity prices is in evidence. The Department of Labor's wholesale price index for May declined three points, or 2 per cent, from the April figure, and the Fisher weekly index again declined one point last week. The recession in this index since the advance was arrested in April has been ten points, or 6 per cent.

The price readjustments of recent weeks are having a wholesome effect in that a better balance between prices of raw materials and other prices is resulting. Since March the decline in the general averages has been confined to raw materials. The Federal Reserve Board's regrouping of the Department of Labor's index shows a decline of six points, or 3.6 per cent, from March to May, while there was no net change in the average for producers', or semi-manufactured, goods and for goods ready for consumption.

The situation in the local building industry is further complicated by the wage advances newly agreed upon. The basic position of bricklayers' wages in relation to the wage scales in other building trades makes it apparent that the collective efforts to stabilize the industry by avoidance of prohibitive costs will face a heavy obstacle in the increased pay of workers in this field.

Bank debits to individual accounts in 247 centers for the week ended June 20 showed an increase of more than 16 per cent over the preceding week, in part due to the mid-month settlements. A special factor was the payment of the second installment of income and profit taxes.

Discounts by the Federal Reserve banks increased \$23,229,000 in the week ended June 20, while deposits declined \$35,009,000, and Federal Reserve Notes in circulation declined \$13,403,000.

MARLIN-ROCKWELL SALE

The Marlin-Rockwell Corp. sold its Philadelphia plant to the Pennsylvania Railroad instead of to the Raybestos company, as announced in AUTOMOTIVE INDUSTRIES.

NEW ONEIDA TRUCK COMPANY

GREEN BAY, WIS., June 26—L. W. Melcher, who was general manager of

the Oneida Motor Truck Co., is the principal corporator of the Oneida Mfg. Co., a new \$400,000 Wisconsin organization which is taking over the interest and will resume the manufacture of the Oneida truck on a quantity basis.

FINANCIAL NOTES

Yellow Cab Manufacturing Co. has declared a monthly dividend of 50 cents a share for one month only, in view of a proposed change in financing. The board of directors contemplates increasing the capitalization and has appointed a committee to report on the proposition at a meeting July 17. The company now has 200,000 shares of common stock, and the belief of those familiar with the company is that this will be increased to 1,000,000 shares. In this case present stockholders would receive four shares for each one now held and would have the right to purchase a fifth share at a price to be decided upon.

Detroit Steel Products Co. has filed in Lansing amendments to its articles of incorporation so that its authorized stock will be \$4,000,000 preferred, \$100 par value, and 250,000 shares of no par value. Of this \$3,132,600 preferred and 142,176 shares of no par value stock will be exchanged for the preferred and common stock now outstanding.

Lee Rubber & Tire Corp. is calling for payment the receiver's certificates of the Republic Rubber Corp., which it recently acquired. These amount to \$1,500,000. The Lee corporation has liquidated other claims against Republic with 65,000 shares of its stock.

Troy Sun Shade Co. has declared an extra dividend of 50 cents in addition to the regular quarterly dividend of 50 cents on the common and the regular quarterly dividend of 1 1/4 per cent on the preferred, all payable July 2 to stock of record June 20.

Overman Cushion Tire Co. has declared a dividend of 24 1/2 per cent on the preferred stock on account of accumulated dividends on that issue, payable July 10 to stock of record June 30.

Smith Wheel Increasing Its Production Program

SYRACUSE, N. Y., June 25—Increased production at the plant of Smith Wheel, Inc., in this city is now under way as the result of greater demand for its products. Double time schedules have been inaugurated in the machine shop and other departments are expected to follow. The plant is now employing 600 persons and this number will be augmented, justified by greater production schedules.

All the gear companies in this city are employing night forces. The Adams Axle Co. has already started its factory here.

ASKS CLIMBER RECEIVER

LITTLE ROCK, ARK., June 27—W. H. Owens of Tulsa as trustee for the bondholders has filed a suit asking for the appointment of a receiver for the Climber Motor Car Corp. and judgment for \$60,019 claimed to be due on the bonds of the company.

Detroit Registered 7757 Cars in May

New Automobile Registrations Show Gain Over 6784 Registered in April

DETROIT, June 26—New cars registered in Detroit during May show a total of 7757 as compared with 6784 in April, according to reports compiled by the Detroit Automobile Dealers' Association. Open car deliveries totaled 4332 and closed 3425 as compared with 3900 open and 2884 closed in April. Truck sales showed an increase from 604 in April to 692.

In the light car field Ford deliveries increased from 2333 to 2591, most of the gain being in closed models which increased from 998 to 1226. Chevrolet increased from 1165 to 1286 made up largely of increased closed deliveries. Star delivered 196, five more than in April, 141 of which were open. Overland delivered 207 as against 152 in April, 152 of which were open. Gray delivered 60 as against 28, 44 being open models.

Buick with 526 deliveries tied the April mark, open cars, however, gaining 24. Studebaker with 439 gained 40 over April, about evenly divided between open and closed. Dodge Brothers with 287 gained 71, also evenly divided. Essex increased from 180 to 233, Maxwell from 140 to 222, Willys-Knight from 136 to 194, Hudson from 142 to 185, Nash from 95 to 123, Rickenbacker from 47 to 100. Hupp with 237 and Jewett, 147, showed slight decreases.

Standing of Other Cars

Oakland increased from 50 to 80; Columbia with 46 and Reo with 43 equaled April exactly, both showing open car increases. Durant increased from 65 to 80, Dort from 15 to 22 and Stephens from 9 to 20. Increases were also shown by Auburn, Chalmers, Cole, Davis, Haynes, Jordan, King, Moon, Stearns and Wills Ste. Claire. Yellow Cab with 10, Courier and Flint, 1 each, made their first appearance in the tabulations.

In the higher priced field Cadillac increased from 60 to 68, Packard with 67 equaled April; Lincoln increased from 16 to 38, all closed but 4; Peerless from 11 to 18, Marmon with 7 fell off 2. Paige fell off from 26 to 21.

In the light truck field, Ford increased from 407 to 432, Dodge Brothers 26 to 32, Chevrolet 18 to 27. In the heavy trucks, Federal increased from 20 to 34, G. M. C. 24 to 33, Standard 6 to 11, White 5 to 22. Reo with 22 and Mack 18 were somewhat under April totals. Other truck registrations showed 4 Denby, 3 Gotfredson, 8 International, 3 Transport, 3 U. S., 5 Ruggles, 3 Packard, 3 Pierce-Arrow, 2 Republic and 2 Signal.

Tractor registrations increased from 14 to 34, Ford having 24, G. M. C. 3, Clark 4, International 2 and Mack 1.

Buick Survey Shows Continuing Demand

Good Sectional Reports Borne Out by Those from Twenty Leading Cities

DETROIT, June 26—The Buick Motor Co. has completed a two weeks' conference with investigators who have made a study of prospective conditions in all parts of the United States. As a result of the reports received, President H. H. Bassett has issued a statement in which he says:

"Our confidence has been strengthened in a continuance of bountiful business through the immediate future and well into 1924, and we shall prepare accordingly."

In making the statement, Bassett said that for some years it has been Buick's custom to dig deeply into fundamental conditions before determining production and selling policies for the ensuing year. Thus, he said, there is brought together at Flint experienced counsel whose duties it is to analyze sectional conditions critically. This group comes direct from its investigations with all information based upon facts.

In addition to the sectional reports, the company received reports on prospective conditions in the twenty leading cities of the country, and these served to amplify and strengthen the sectional reports, Bassett said. Taking the reports as a whole, he said the company is justified in anticipating that the 1924 season will again break Buick sales records. The Buick fiscal year just closing will run far in excess of all previous years, the aggregate increase in the twenty cities over the best previous year being 128 per cent.

June sales will maintain the pace set during the rest of the year, Bassett said.

Closed Car Shortage Felt in California

LOS ANGELES, June 25—Southern California motor car dealers have begun to worry over the demand for closed cars and the inability of the factories to meet the requirements. Open models have begun to accumulate in stock, and a shortage of closed cars exists. Telegrams, letters and personal visits to the factories get no results, the dealers say, and they are beginning to show some signs of alarm.

The situation does not apply to the higher priced cars alone. The Chevrolet and Ford are in the same situation as others. The closed car demand has developed in the outlying districts just as pronouncedly as in the city. A Ford dealer in a town of 300 twelve miles from Los Angeles reports his orders are for sedans and coupés almost exclusively, and this state of affairs is general.

The only ray of sunshine in the situation is that owners of open cars who

desire to trade on closed cars are giving the dealers more of an opportunity to select their customers. Cash buyers are getting what closed cars are available.

However, there are not enough of this class of buyer nor enough closed cars to permit dealers to operate on this trade exclusively. Californians used to laugh at the thought of a closed car. This was proclaimed an outdoor country and a dealer who disposed of half a dozen closed models in a year thought he had done a big business. With conditions changed a really serious problem has developed.

INDUSTRIAL NOTES

Blakely Manufacturing Co. of Detroit has purchased the stamping machinery and equipment of the Liberty Stamping & Manufacturing Co., which it has removed to its new factory at Fullerton Avenue and Monnier Road. With this additional equipment the Blakely company expects greatly to enlarge its production of automobile fastenings. The Liberty company will concentrate upon the manufacture and sale of its enameled metal tables.

Elk Manufacturing Co. of New York City has taken over the Elk Machine Tool Corp. with increased capitalization. J. G. Elkin is president of the new company and will have charge of manufacturing and production. The company will continue to manufacture and sell Precision tools under the Elkin patents, with a plant at 243 West Seventeenth Street, New York. It will have direct representatives and branches in about twenty-five cities of the United States.

American Window Glass Co. directors held their last meeting prior to the taking over of the company by Durant Motors, a transaction involving \$5,000,000. The affairs of the board were wound up and preparations made for the entry of the new board. Durant Motors, through the purchase, comes into possession of the extensive glass plant at James City, three miles from Kane, Pa.

Moto-Meter Co. has purchased a large plot opposite its plant in Long Island City, N. Y. The plot contains an area of 45,000 sq. ft., which will be used later on for a new plant.

Springfield (Mass.) Malleable Iron Co. practically has completed alterations of the Harley foundry, recently purchased, and has erected a large addition in which is being installed a new furnace. Manufacture of castings for automotive parts has commenced and operations will be increased throughout the summer and fall.

Pennsylvania Rubber Co. of America has changed its official title to Pennsylvania Rubber Co. of America, Inc.

WANTS ALLEN TIRE TO RESUME

ALLENTOWN, PA., June 25—At a meeting of the stockholders of the defunct Allen Tire & Rubber Co., Attorney John L. Lordan suggested that the company reorganize and resume operation of the plant.

SAGINAW AUTHORIZES BUSES

SAGINAW, MICH., June 26—The city has granted a fifteen year franchise to a new transportation company which will operate street cars with motor bus auxiliaries and extensions.

METAL MARKETS

"Clean-up time," the annual period for repairs and adjustments in steel mills, which is usually set for Fourth of July week, got under way this week at a number of the Mahoning valley sheet mills. Among these plants, whose output will be considerably curtailed during the next few weeks, are several that specialize in the production of automotive sheets. To some extent, therefore, the slowing up in the demand that has come over the market will be offset within the next few weeks by curtailment of output. The dent in production caused by what in the case of some mills will amount to a two weeks' suspension will act to some extent as a prop for the market.

Absorption of steel during the heated term is, of course, retarded also, but during this period of impaired steel production and consumption quotations are likely to remain unaltered for want of any substantial reason for changes. The truth of the matter is that in spite of all the emphasis that is laid on the backlog of orders, which steel mills have to carry them over into the year's last quarter, the market waits for a reawakening upon a fresh buying movement from the automotive industries. Until the first signs of renewed interest in steel by passenger motor car manufacturers manifest themselves, the market is certain to be a dull affair, and steel producers, comfortably fixed as they may be with reference to orders for railway equipment and other heavy steel products, have their eyes turned to Detroit, whence must come the first sign of a resumption of buying.

Prices are maintained for the present largely because there is not sufficient new buying to move them one way or the other. Such a condition, however, never lasts beyond a limited time in the steel market. Either the next four or five weeks will show that another buying movement is in the formative stage or else some of the producers, being somewhat more urgently in need of business than their competitors, will go energetically after business, and such bidding for orders always carries with it the implication that prices are subject to discussion. Automotive specialty steel makers report that they continue to make shipments of good-sized tonnages on account of previously placed contracts. Alloy steel makers, for a long time during the rush, were unable to catch up with the orders which piled on to their books. At one time a leading maker of alloy steels could make no deliveries earlier than three months after the placing of orders, but the end of deliveries against these orders is now in sight.

Pig Iron.—Prices are still on the toboggan, and what few orders are placed by automotive foundries come in for the most intensive competition between pig iron sellers. Even on single car orders for foundry and malleable there is no uniform price, sellers slashing quotations so as not to let any business get away from them.

Aluminum.—The sole domestic producer continues to be in arrears in shipments against contracts, and does not figure as a seller in the current spot or prompt market. Importers are applying what limited tonnages they receive from abroad to previous commitments. A few odd lots of Italian and Swiss metal come on the market here and there.

Copper.—Manufacturers of copper and brass products report that there has been a sharp falling off in buying by Detroit automotive consumers who are said to have overbought earlier in the year.

Calendar

SHOWS

Nov. 4-10—New York, First Automobile Exposition of the Foreign Automotive Association, Hotel Astor.
Nov. 11-17—New York, Annual Automobile Salon, Hotel Commodore.
Jan. 26-Feb. 2—Chicago, Annual Automobile Salon, Hotel Drake.

FOREIGN SHOWS

Oct. 4-14—Paris, Passenger Cars, Bicycles, Motorcycles and Accessories, Grand Palais.

Oct. 15-20—London, Motorcycle Show, Olympia.

Oct. 24-Nov. 2—Paris, Trucks, Agricultural Tractors, etc., Grand Palais.

Nov. 1-15—Buenos Aires, Annual Automobile Exposition, under the direction of the Automovil Club Argentino.

Nov. 2-10—London, Automobile Show, Olympia.

Nov. 22-Dec. 1—London, Motor Transport Exhibition.

Dec. 8-19—Brussels, Passenger Cars, Trucks, Airplanes and Motor Boats, Aviation Palace.

RACES

July 2—Tours, French Grand Prix 500-mile race.

Sept. 3—Annual Pike's Peak Hill Climb.

Oct. 28—Barcelona, Spain, Grand Prix for vehicles of 1500 c.c.; Nov. 1, International Grand Prix for cycle cars of 1100—Nov. 4, International Grand Prix for two liter.

CONVENTIONS

Oct. 24-26—Cleveland, Thirtieth Annual Convention of the National Association of

Farm Equipment Manufacturers, Hotel Statler.

Nov. 12-17—Chicago, Annual Business Exhibit and Convention of the Automotive Equipment Association, Coliseum.

S. A. E. MEETINGS

Oct. 25-26—Production Meeting of the S. A. E.—Cleveland.

Jan. 1924—Annual Meeting of the S. A. E.—Detroit.

MEETINGS

Sept. 19-21—Boston, Fall Meeting of the Motor and Accessory Manufacturers Association.

California Will Tax Earnings of Vehicles

LOS ANGELES, June 25—Despite his pre-election promises that he was opposed to increased taxation in any form, Governor Richardson has signed the bill passed by the California Legislature providing for a tax of 4 per cent on the gross receipts of motor vehicles operating under Railroad Commission certificate.

The bill was opposed strenuously before the Legislature, but it was adopted on the basis that the revenue thus derived is necessary for highway maintenance. This tax will be in addition to an estimated \$36,000,000 which will be raised from motorists under the new registration and weight fee basis and 2 cents a gallon gasoline tax.

There is a probability that the constitutionality of the gasoline tax will be attacked in the courts. The bill provides, however, that should it be proved unconstitutional, the old form of horsepower tax will be reapplied. Although operators have paid their license fee on the horsepower basis for 1923, the gasoline tax will become effective Oct. 1 and be an additional levy.

The automobile clubs were the chief advocates of the gasoline tax. Their selling argument was that a gasoline tax meters the use of the roads. The tax applies to all motor vehicle fuels, except kerosene, and is to be collected at the source. Therefore it will be included in the price consumers pay for their fuel at filling stations.

John T. Stockton, Head of Transfer Firm, Dead

MILWAUKEE, June 25—John T. Stockton, president of the Joseph Stockton Transfer Co., a leading transfer company in the store-door delivery movement, died today of heart trouble at the age of fifty-five. He was a delegate to the United States Chamber of Commerce meeting in New York City in May and was taken ill immediately after the meeting.

More than thirty years Mr. Stockton guided the affairs of the company

organized by his father, Gen. Joseph Stockton, sixty-five years ago. He handled with his 100 horse-drawn vehicles and two motor trucks the freight collection and distributions for the New York Central, Pennsylvania, Erie, Chicago & Alton and other railroad lines. He was one of the leading exponents of transfer work in the country for motor transport.

Chicago Reports Upward Movement in Time Sales

CHICAGO, June 25—Retail sales of automobiles on the time payment plan have been fairly well sustained for the last month at a level somewhat below that of April and the first part of May, according to figures compiled by the Central Automobile Finance Association. Dating from the middle of June there is now in evidence a slightly upward trend in such sales.

As compared with the corresponding period last year the time payment sales recorded with the County officials have been considerably less. This is probably due to the fact that some of the larger finance companies financing the sale of low priced cars have discontinued filling their chattel mortgages for record, rather than to an actual decline in sales.

The number of time payment sales recorded for the seven weeks ending June 16 this year was 5492. For the similar period last year the number was 7618. The largest number recorded in one week so far this year was 1082 for the week ending April 28.

Sales thus far in June have been recorded as follows: 618 for week ending June 2; 686 for week ending June 9; 767 for week ending June 16.

FIAT RACE DRIVER KILLED

PARIS, June 19 (by mail)—Ernest Lampiano, Fiat race driver, was killed while practising for the Faucille hill climb, in Switzerland, on a 122 cu. in. racing car. He had only driven for Fiat during the last two years, principally in hill climbs and local events. He had been attached to the racing department for a number of years and had ridden as mechanic with Scales, Cagno, Louis Wagner and Felice Nazzaro.

New Bombing Plane Built for British

LONDON, June 19 (by mail)—The new bombing airplane reported to have been built by Messrs. Boulton and Paul of Norwich, England, for the British Air Ministry is declared to be the last word in airplane construction for either war or commercial purposes.

The plane is built entirely of steel. It is the largest machine of its type ever constructed, yet it is propelled by two engines as against four in the old-time war bomber. Two tractor and two pusher propellers are placed in either side of the body, one behind the other. The engines are installed in a cabin, completely armored against machine-gun attacks.

The engine room is so equipped as to provide for a mechanic, and the pilot will have his station forward and will control the throttle, steering and lifting. Machine guns are carried fore and aft. The two sets of propellers are so designed that if one set is disabled by accident or attack, the airplane will be supported and propelled by the other.

Much secrecy is thrown about the construction of the ship as to its design, power and speed. Tests will be made shortly to show what weight of bombs the airplanes will carry and what speed it actually will attain.

Back Lots Suggested for Garages Downtown

RICHMOND, VA., June 25—Allen J. Saville, director of the Department of Public Works, recommends in his annual report that the city use the back lots in the business district as sites for parking buildings.

In the report he says:

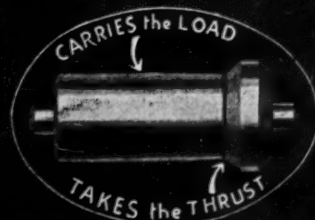
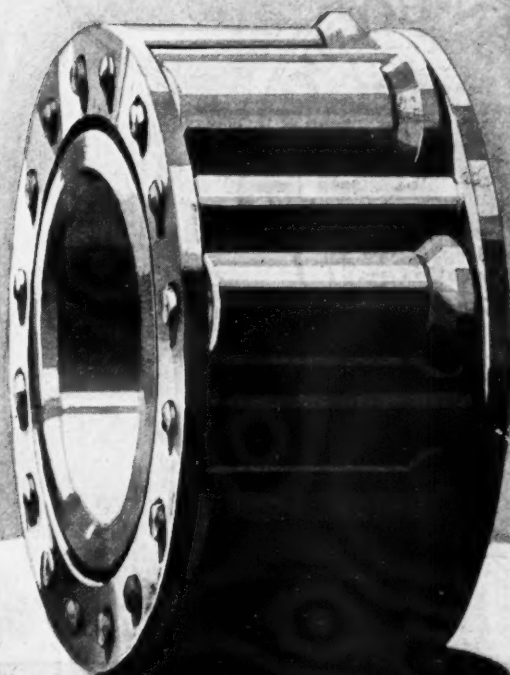
Like every other city, we have a parking problem. Due to the layout of the city, there may be a solution of this for us here that will not prove very expensive. Our lots are, as a rule, very deep with an alley running through the block.

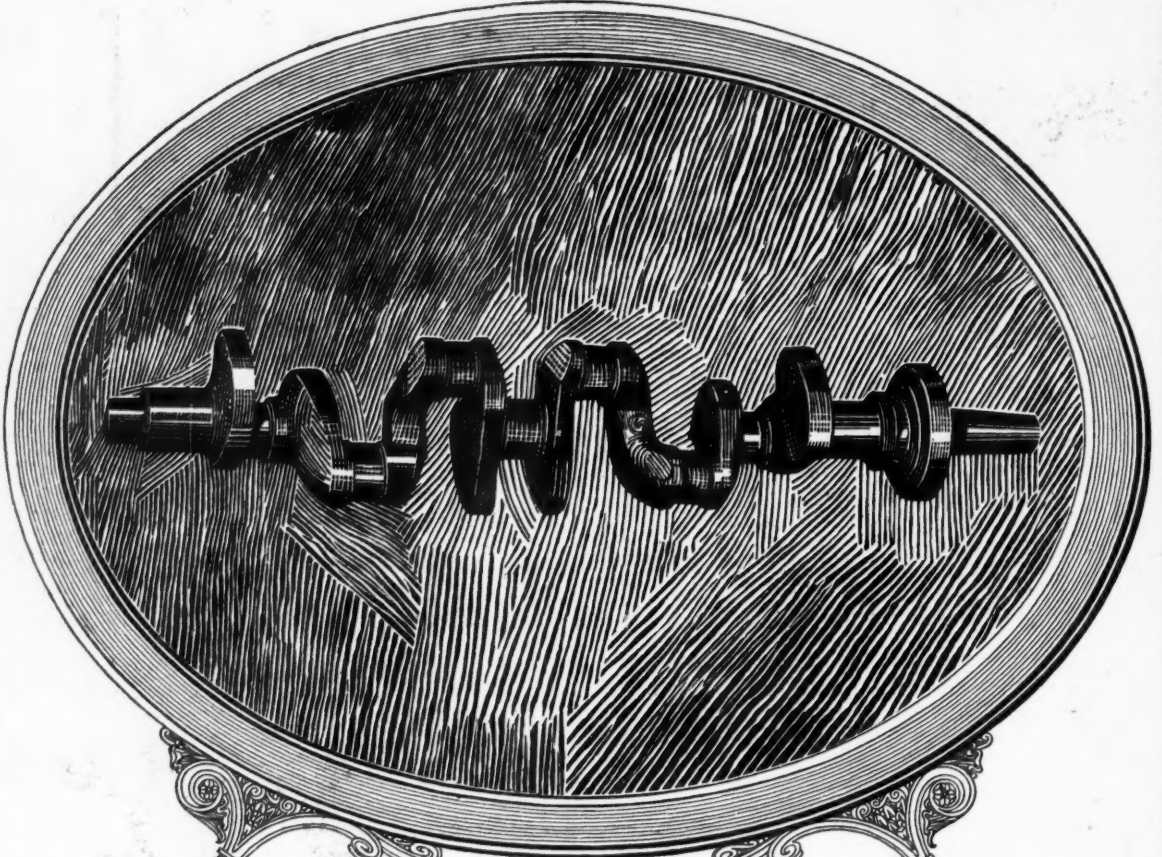
It might prove advisable for the city to purchase land on the rear of these lots in the heart of the block and build two or three-story garages which would care for more cars than can be parked around the block now.

When an engineer specifies Bower Roller Bearings for a car or truck, he knows that *there* is one part he can conscientiously forget about. -- They seem to serve everlastingly with no adjusting or no additional service. And to manufacturers, as well as car owners, this is of inestimable value.

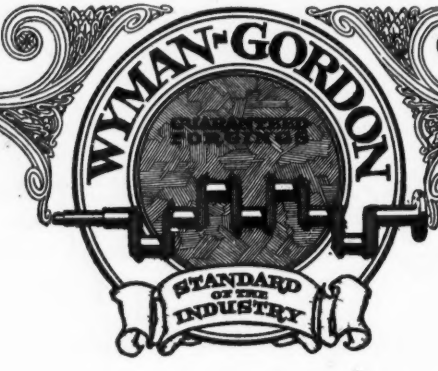
Bower Roller Bearing Company
Detroit, Michigan

BOWER
ROLLER BEARING CO.
Detroit - Michigan





Made at Crankshaft Headquarters



FOREMOST IN
SCIENTIFIC DEVELOPMENT

AUTOMOTIVE INDUSTRIES

AUTOMOBILE

THE CLASS JOURNAL COMPANY
239 WEST 39th STREET NEW YORK CITY

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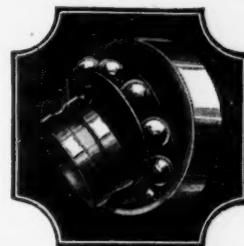
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For Lighting Generators and Ignition Apparatus



"NORMA" PRECISION BALL BEARINGS

One magneto or lighting generator bearing may cost a trifle more than another. At most, that difference is but the smallest fraction of one per cent of the total cost of the car, truck or tractor in which it is to be used. Yet that small price difference may represent added value of tremendous effect upon the ultimate earning power of the car, truck or tractor.

Magnetos and lighting generators having "NORMA" Precision Bearings continue, through the years of changing standards, to be the standard equipment on cars, trucks and tractors of the better class—simply because the added value in the "NORMA" Bearings themselves is multiplied many fold in the over-all service capacity of the automotive unit.

Service records prove that magnetos and lighting generators equipped with "NORMA" Precision Bearings run more quietly, last longer.

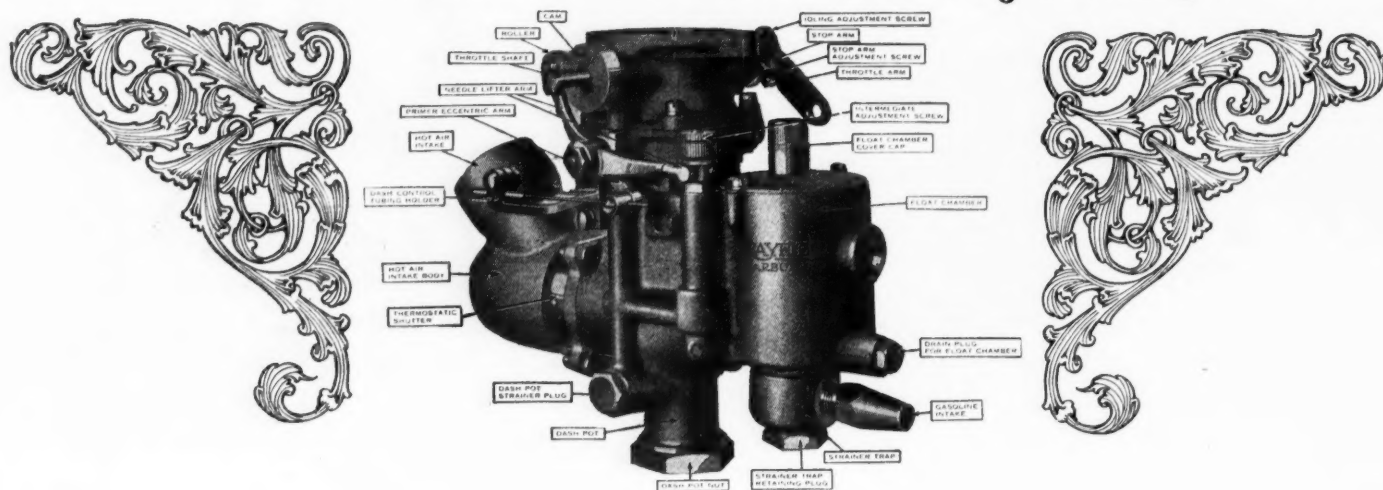
*A booklet will be sent on request.
And our engineers will welcome
an opportunity to work with
yours.*

THE NORMA COMPANY OF AMERICA

Anable Avenue
Long Island City New York
BALL, ROLLER AND THRUST BEARINGS

RAYFIELD CARBURETOR

"Has Never Been Out-Performed"



The New Model ST Rayfield

The changing requirements of a carburetor due to improved engine standards are responsible for the design of the new Rayfield ST.

Still of the expanding type, as always, the new Rayfield has been perfected without the usual air valves. It represents the utmost simplicity in carburetion.

Some of its outstanding features are its expanding venturi, thermostatic air control, dash needle adjustment and built-in primer.

In competitive tests for twelve years Rayfields have "never been out-performed."

Some Facts About Efficient Carburetion

The primary function of a carburetor is to provide a mixture of air and gasoline as fuel for the engine; for the highest efficiency this mixture must be of the ratio of 15 parts of air to one of gasoline, by weight, under all loads and at all speeds. Rayfield carburetors have always been of the expanding type to insure this fundamental.

BENEKE & KROPF MFG. CO.

21st and Rockwell Sts.

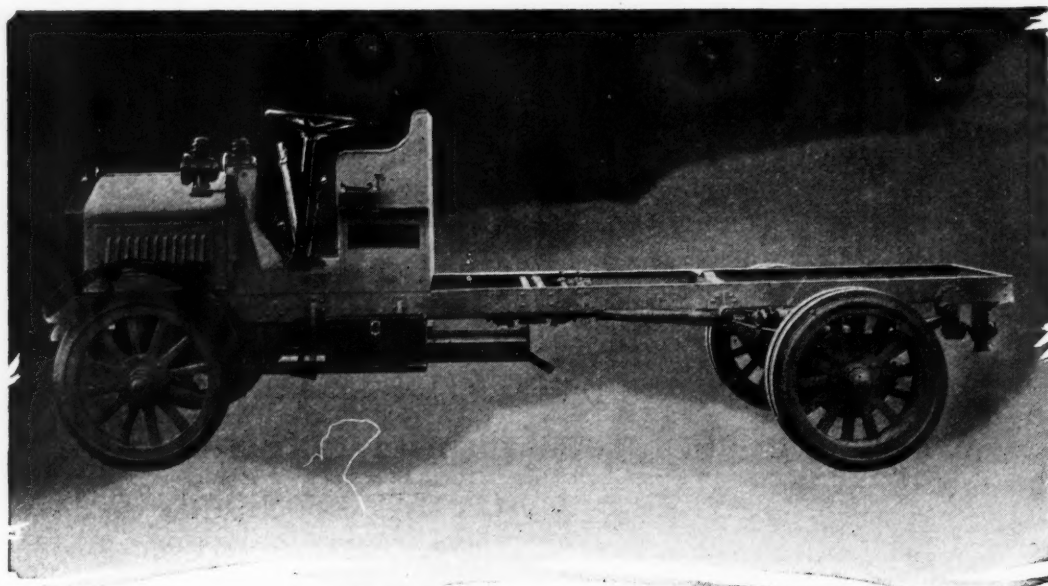
Chicago, Ill.



THIS number carries to you the general consideration of the important engineering problems, the high spots of the discussion at the S. A. E. convention and other material suitable for the annual Engineering issue.

The next issue of Automotive Industries will carry a complete story of the Body Builders' convention to be held in Detroit during the week.

HARRY TIPPER.



Ball Bearings on Worm Shaft Prolong Engine and Truck Life

THE success of worm drive is largely dependent upon the ability of the worm thrust bearings to take the very heavy loads when starting, running in low gear and climbing hills, with a minimum amount of frictional resistance. Unless the bearings meet these conditions, the performance of the car or truck is impaired, the engine overloaded and the whole truck mechanism subjected to severe shocks and jerks.

An **SKF** marked self-aligning, self-contained, double-thrust ball bearing eliminates these difficulties on the truck

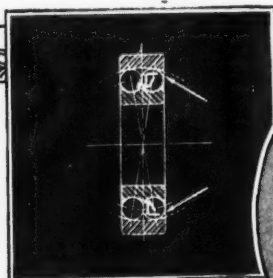
illustrated. Since the small amount of friction in a ball bearing is practically the same when starting as when running, no appreciable reserve engine power is necessary to overcome starting friction and the worm mechanism operates smoothly and efficiently under all service conditions. And a further betterment of performance is obtained through the use of two self-aligning radial bearings on the propeller shaft.

Our engineers will gladly submit ball-bearing recommendations for all vital rotating parts.

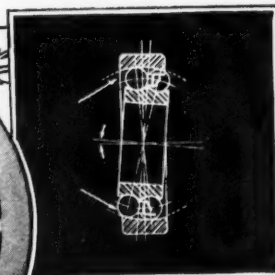
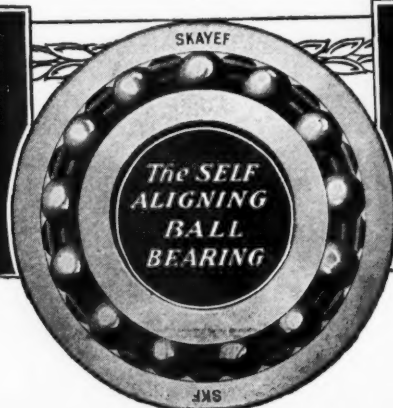
THE SKAYEF BALL BEARING COMPANY

Supervised by **SKF** INDUSTRIES, INC., 165 Broadway, New York City

994

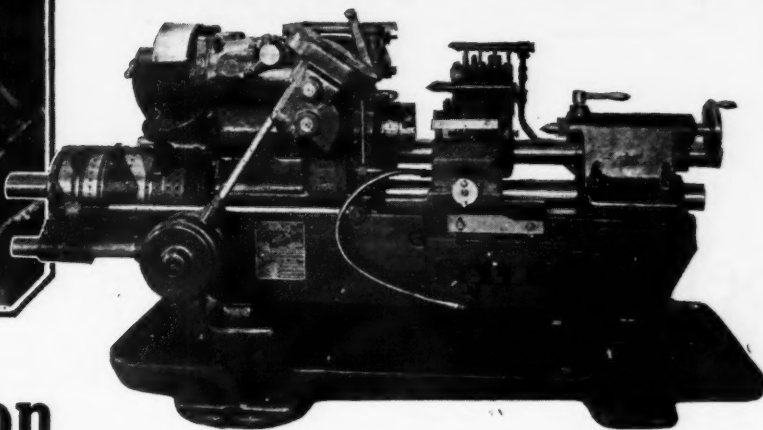
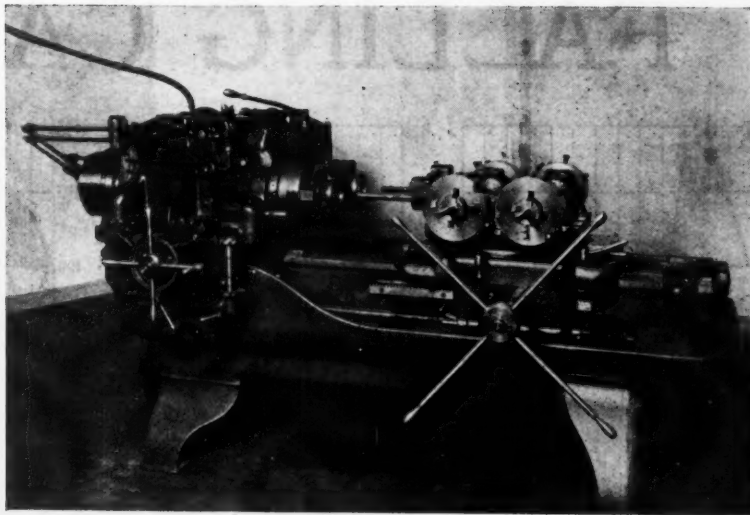
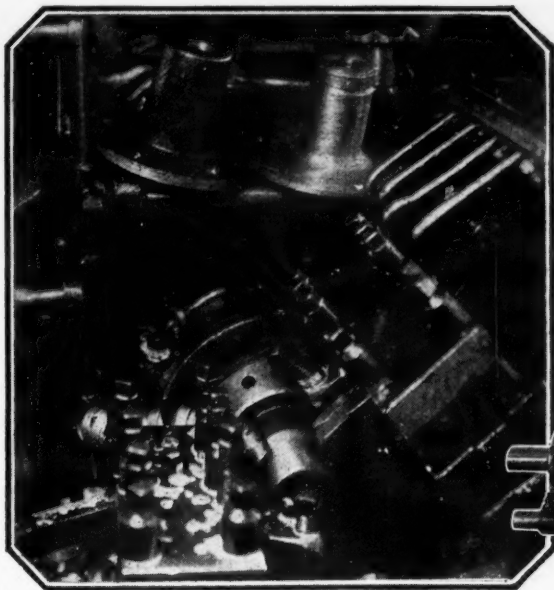


Normal View



Deflected View

BALL BEARINGS
The Highest Expression
of the Bearing Principle



This Combination for Sustained High Production

AS an indication of the trend of the industry toward buying **PRODUCTIVE ABILITY** rather than mere machines, we point to the ever-increasing demand for our Double Spindle Flat Turret Lathe and the Fay Automatic Lathe as a combination.

This combination is maintaining an enviable reputation, winning against other methods of machining such au-

tomotive parts as differential housings, hubs, drive pinions, transmission gear blanks, and other work requiring the second operation to be done on centers.

In this combination of machine-tools, we believe we have something of real importance. Production men not getting comparable output on similar work are invited to communicate with us.

**HARTNESS DOUBLE SPINDLE
FLAT TURRET LATHE**

FAY AUTOMATIC LATHE

JONES & LAMSON MACHINE CO.

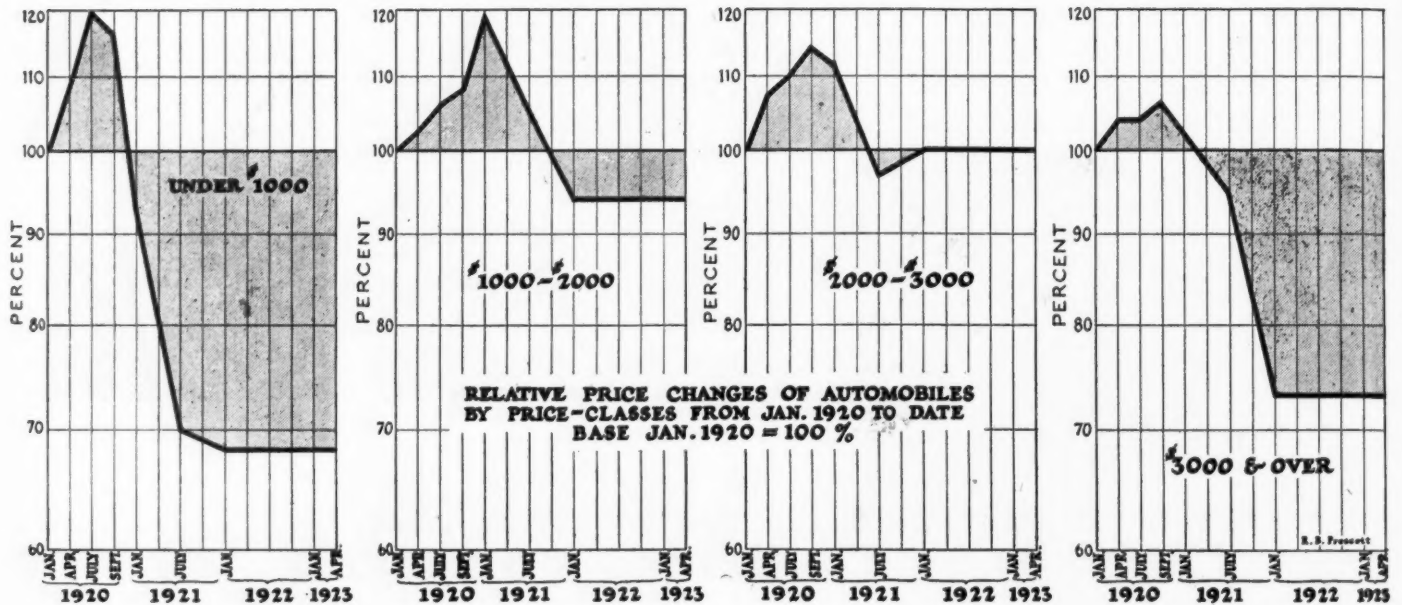
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San Francisco, Cal.

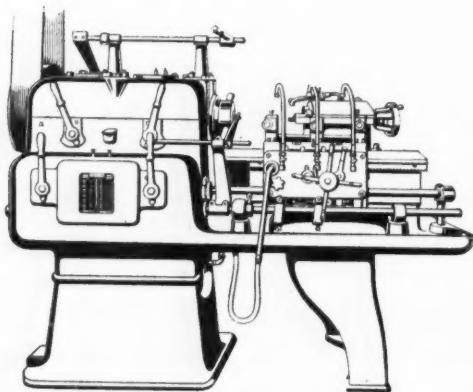
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FALLING CAR-PRICES



**Selling Prices are Down—
Raw Material Prices Still Up—**
Greater production per unit the Solution



The NEW Lo-swing semi-automatic lathe offers any turning department greater production—regardless of its present output. The very latest design and construction in production equipment for rapid turning. Cutting tools supported close up to the cutting-edge—eliminating all overhanging arms and other remote supports. RIGIDITY to a degree permitting multiple cutting tools to operate at feeds and speeds limited only by the endurance of the high-speed steel available.

While the NEW Lo-swing semi-automatic lathe is 100% special for a job when properly tooled for it, it is at the same time 90% standard. When the work changes, it is only necessary to change the tooling. In these days of frequent changes in design this is something to keep in mind.

SEND US YOUR BLUEPRINTS for time estimates—we will show you something interesting.

Fitchburg Machine Works, Fitchburg, Mass.

REPRESENTATIVES: Detroit and Cleveland District, W. H. Nettle, 236 Riehton Ave., Highland Park, Detroit, Mich. Chicago, Milwaukee and St. Louis District, W. A. McCarrell, 429 Kenwood Boulevard, Milwaukee, Wis. New York State, W. H. Dana, 137 East Brighton Ave., Syracuse, N. Y. Southern Continental Europe, G. E. Fogarty, 42 Rue de Peletier, Paris 9e, France. British Isles, Buck & Hickman, Ltd., 2 and 4 Whitechapel Road, London, E1, England.

The NEW
Lo-swing Lathe

Sylphon
TRADE MARK

temperature regulator keeps Duesenberg motor
at degree of highest efficiency for 3155 miles, non-stop

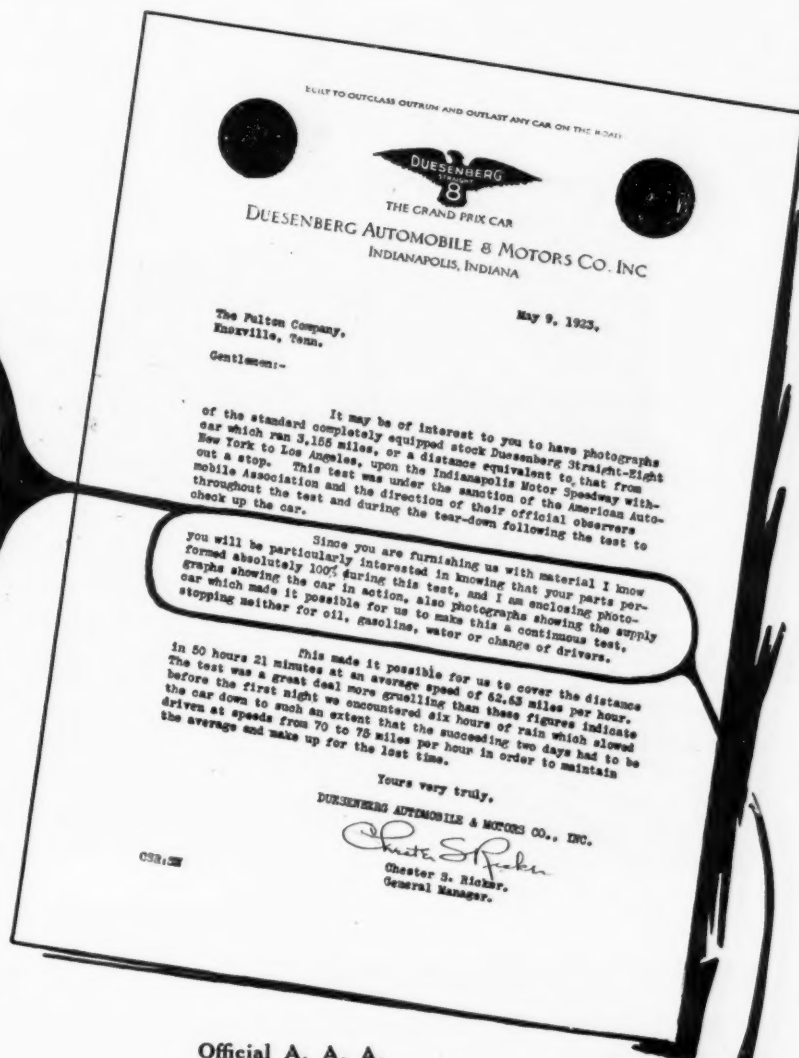


Sylphon Automobile Temperature Regulator consists of three main parts: the Sylphon—that seamless, solderless, flexible, all-metal expansion member, which is the heart of all Sylphon products; a valve and a housing for the Sylphon. The Sylphon is filled with a highly volatile liquid, which vaporizes at a pre-determined temperature, expanding the Sylphon and opening the valve to admit water and contracting and closing the valve when the temperature falls. Is self-regulating, adapted to pump or thermo-sylphon cooling systems, can be installed between the regulator and the engine, either in outlet or inlet water connection. Has no moving parts to wear out, needs no oiling and will outlast the motor. Do not accept imitations or substitutes. We are the originators, patentees and manufacturers.

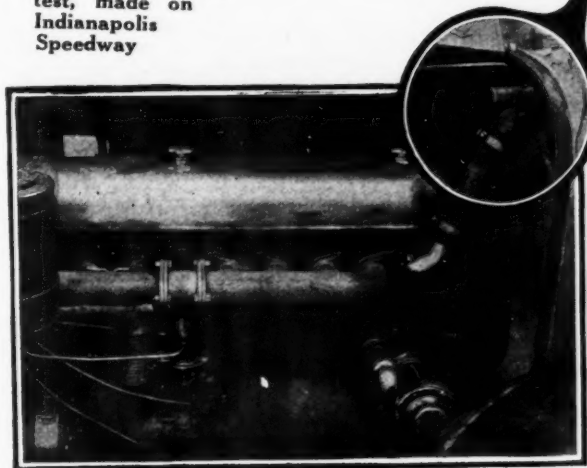
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Standard Equipment on these Automobiles

American-La	Lafayette	Roberts
France	Lancaster	Rolls-Royce
Bay State	Leyland	Stevens-Duryea
Bell	Lincoln	Straker-Squires
Case	Mitchell	Twin City
Cadillac	Napier	U. S. Tractor
Climax	Packard	Vulcan Truck
Columbia	Paige-Detroit	Ward-La France
Cunningham	Pierce-Arrow	Westcott
Kiesel-Kar	Premier	Wisconsin

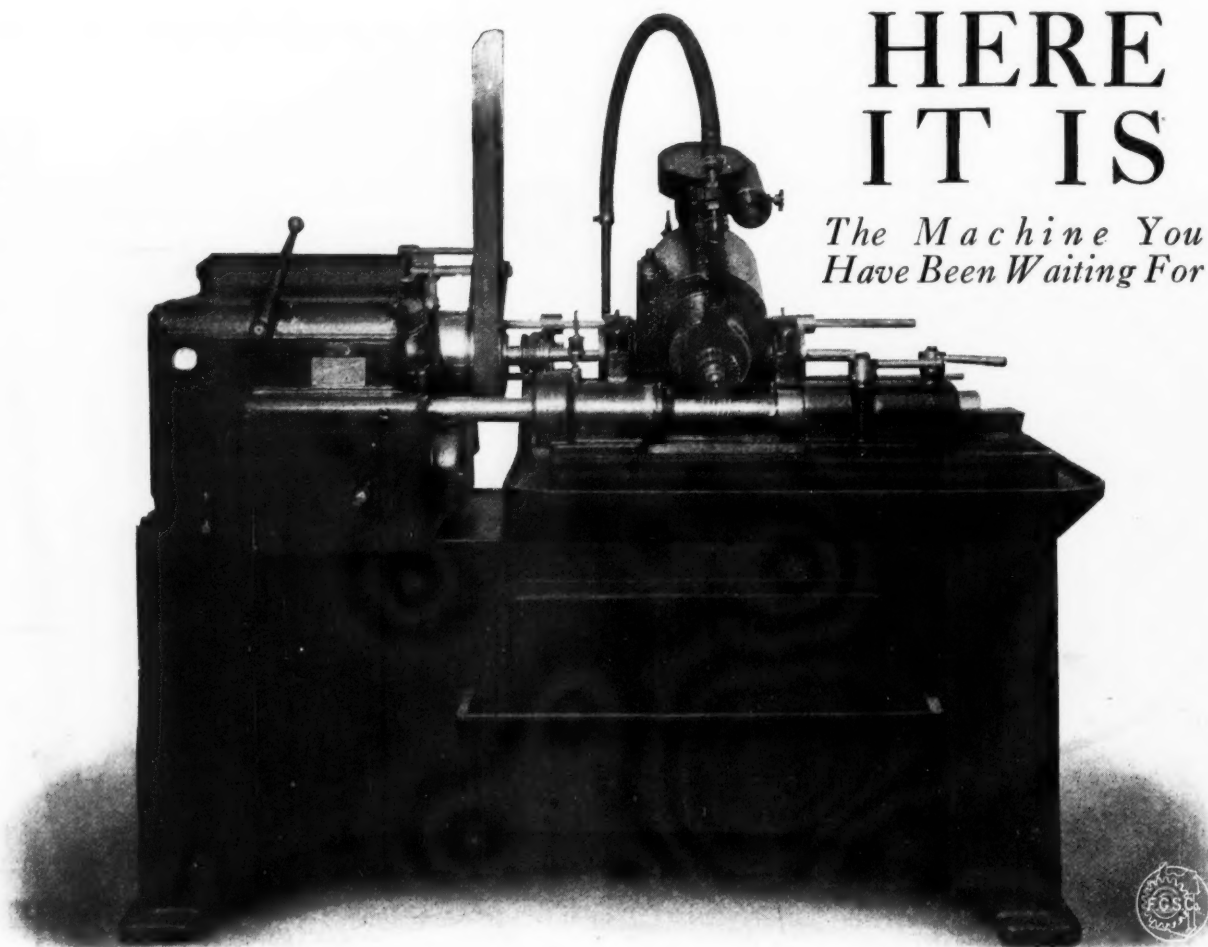


Official A. A. A.
test, made on
Indianapolis
Speedway



THE FULTON COMPANY—Knoxville, Tennessee

New York Chicago Detroit Philadelphia
Representatives in all Principal Cities



The Fellows Gear Shaper Co. Thread Generator.

A Thread Generating Machine having remarkable production possibilities.

It uses a helical Gear Shaper cutter and produces worm threads with an ease and dispatch that is almost startling.

You can now generate worm threads anywhere from three to five times as rapidly as was ever possible before, and at the same time get more accurate work.

A companion machine to the High-speed Gear Shaper, and another solution to the reduction of Labor Costs.

If you cut threaded work in quantities, you will want one of these Thread Generators.

Yes! We have a booklet that describes it completely.

Do you want a copy?

THE FELLOWS GEAR SHAPER COMPANY

SPRINGFIELD, VERMONT, U. S. A.

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Announcement



M. YOUNG and associates, under the name of Racine Radiator Company, have purchased the Perfex Radiator Company—its entire plant, patents, properties and assets. The company will continue under the active management of Mr. Young, vice-president.

Production has already been greatly increased to meet the pressing demand for Perfex Radiators; but further important changes will follow rapidly.

This company is already one of the largest makers of radiators, supplying its product to about 70 leading manufacturers of trucks, tractors, industrial machinery and power units. In addition to this it manufactures a full line of quality replacement radiators for Ford and Chevrolet cars.

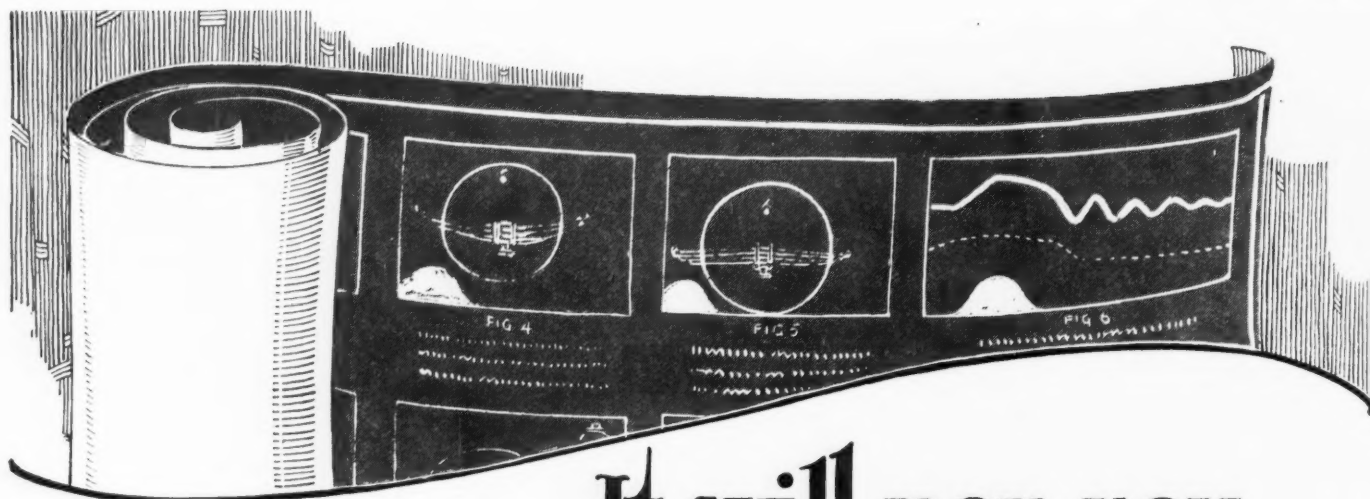
Broad, systematic plans for more thorough co-operation with all who handle or use Perfex Radiators will be announced soon, and with our increased production facilities we are in a position to be of genuine service to any user of radiators. Correspondence invited. Quotations and engineering service with no obligation.

RACINE RADIATOR COMPANY, Racine, Wis.

Dept. W.

Manufacturers of

PERFEX
THE PERFECT RADIATOR



It will pay you to send for this *Blue Print*

EVERY automotive engineer in the country should have this blue print.

It explains clearly, from an engineering standpoint, why Gruss Air Springs are so necessary to every truck, bus and passenger car.

After you have seen it you will readily understand why one great oil company has over 700 oil tank trucks and salesmen's cars Gruss equipped; why so many bus companies have made Gruss Air Springs standard equipment; why thousands of passenger car owners are frank

to say they would never drive another car without them.

From the standpoint of both economy and comfort, Gruss Air Springs are causing nation-wide comment.

Two well-known manufacturers of motor buses have already made Gruss Air Springs standard equipment. Others are going to follow in rapid succession.

Sooner or later you are going to be asked what you know about Gruss Air Springs.

We will gladly send you complete information on request.



THE CLEVELAND PNEUMATIC TOOL CO.,
CLEVELAND, OHIO.

GRÜSS AIR SPRINGS

AS MANUFACTURED BY THE CLEVELAND PNEUMATIC TOOL CO

*Make all Roads
Boulevards*





*Angular Contact Thrust
Bearings*

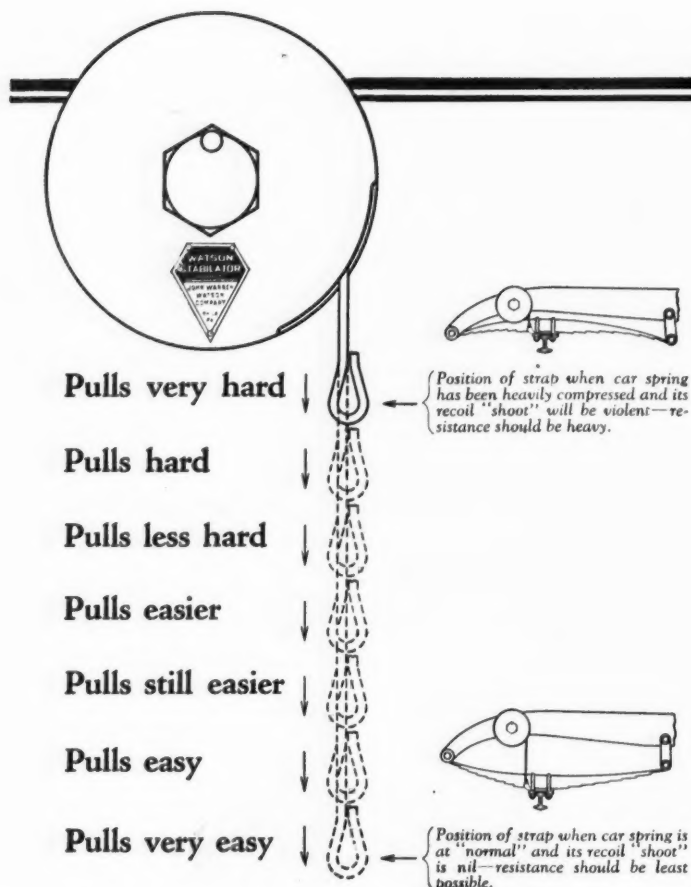
*Angular Contact Radial
Bearings*

These Bearings furnished
to your requirements.

Send us your blue-prints
and inquiries.



The
BEARINGS COMPANY of AMERICA
LANCASTER, PENNA.
DETROIT OFFICE—1012 FORD BLDG.



Have you ever made this test?

Clamp any so-called recoil check in a vise and then pull on the strap. According to whether the strap pulls easier-and-easier, or harder-and-harder as you continue to pull it out, you can tell whether the device is right or wrong.

YOU will find that a Stabilator strap, as above illustrated, pulls easier and easier as you keep pulling it out. Thus a Stabilator is not,

in effect, a jump strap, but is a brake which automatically holds heaviest when the recoil force is violent and holds but gently when the recoil force is mild.

It is only logical to put a small brake on a Ford car and a very large and powerful brake on a Mack 5-ton truck. Watson Stabilators apply this same logic to the varying forces of spring recoil.

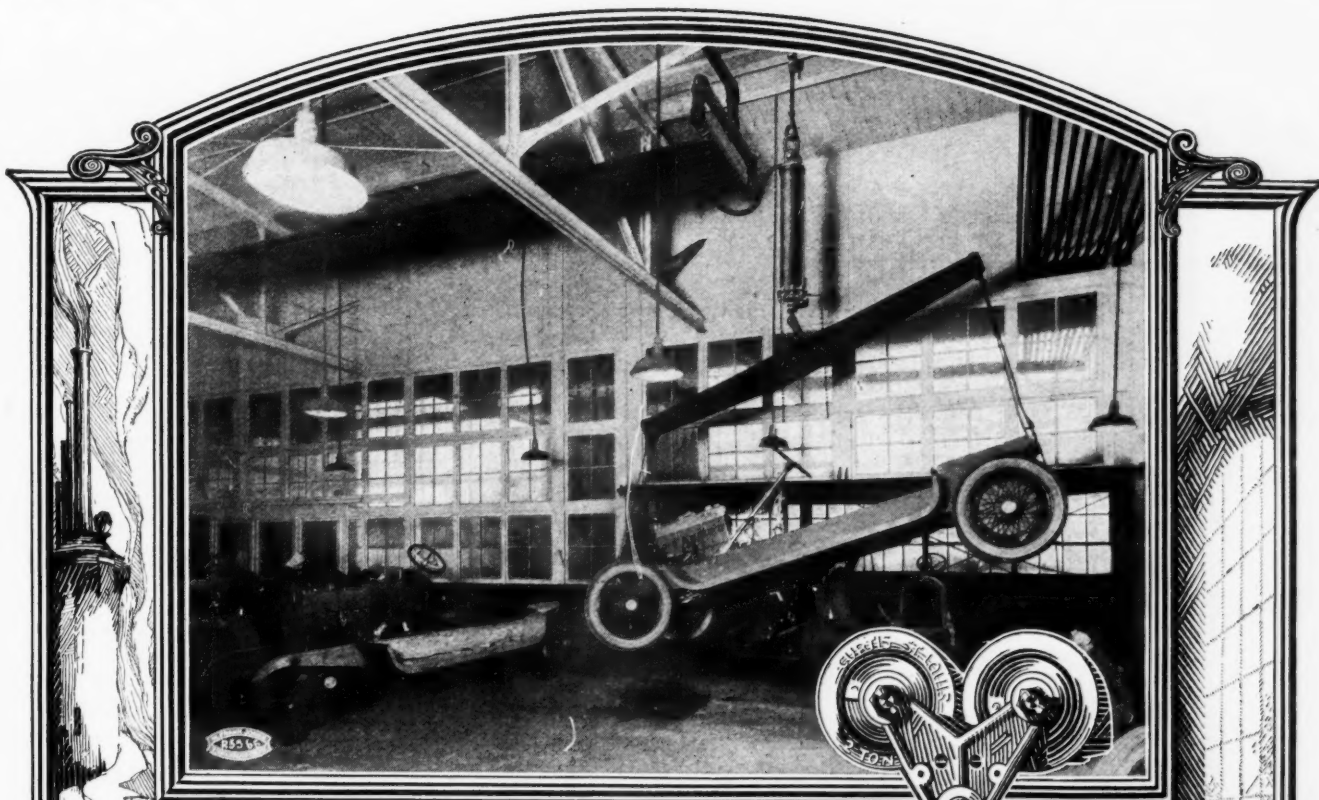
You need not take anyone's "say so" as to whether or not a device gives correct proportional resistance—just clamp the thing in a vise, pull on the strap, and see what it gives.

JOHN WARREN WATSON COMPANY
Twenty-Fourth and Locust Streets
Philadelphia



WATSON STABILATORS

CHANGE THE WHOLE NATURE OF YOUR CAR



CURTIS AIR HOISTS *in the* Automotive Industry

THE above photograph, taken in one of the largest and most progressive automobile plants, shows one of many uses to which Curtis Air Hoists have been applied.

Curtis All-Steel Air Hoists and Curtis Roller-Bearing Trolleys are solving many production problems—they are cutting costs in manufacturing plants throughout the automotive industry. Write us for full information.

Also Manufacturers of Curtis I-Beams, Cranes and Curtis Air Compressors

CURTIS PNEUMATIC MACHINERY CO.

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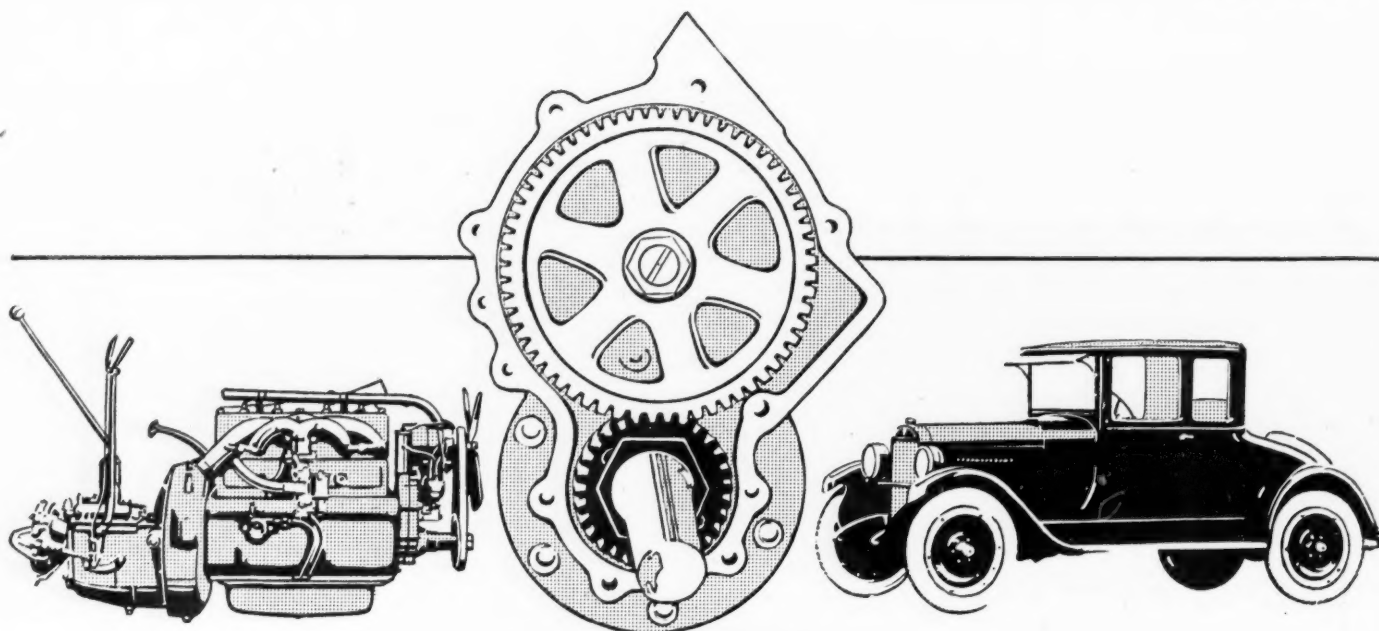
Canadian Representative, Joseph St. Mars, Winnipeg and Toronto, Canada.



Established 1854



"Lift it with Air"



FORMICA
in
MAXWELL
design

MAXWELL is another company of high engineering standards that has found Formica gear blanks effective in getting the proper silence for the timing train, while retaining the well-tried and proven gear drive.

Maxwell used Formica in the crankshaft gear — thereby getting silence with the use of a small blank. Like other users, who know how to use Formica, Maxwell has found that Formica blanks produce satisfactory quietness, greatly reduce the necessity of selecting gears, and bring the percentage of tear down of nearly completed engines almost to nothing.

Write for the facts.

THE FORMICA INSULATION COMPANY
4622 Spring Grove Ave., Cincinnati, Ohio

FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS

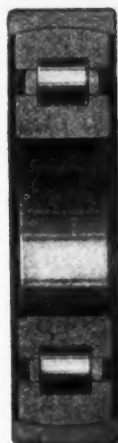
HOFFMANN

PRECISION ROLLER BEARINGS



"R" TYPE

Made to standard metric dimensions in light, medium and heavy series; interchangeable in size with standard ball-bearings. Made to inch dimensions in light and medium series.



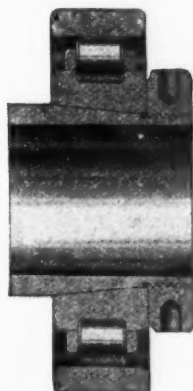
"RN" TYPE

Self-aligning

Made to metric dimensions in light, medium and heavy series. Made to inch dimensions in light and medium series.

"RT" TYPE

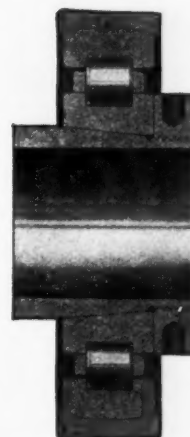
Equipped with clamping sleeve and nut. Made to inch dimensions in light and medium series.



"RTN" TYPE

Self-aligning

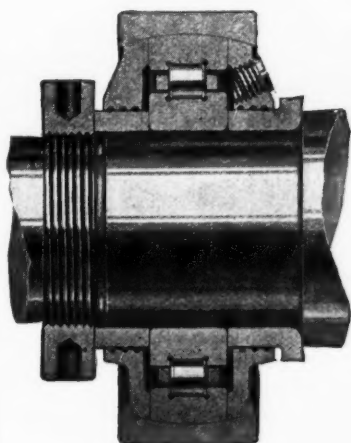
Equipped with clamping sleeve and nut. Made to inch dimensions in light and medium series.



"RTW" TYPE

Self-aligning

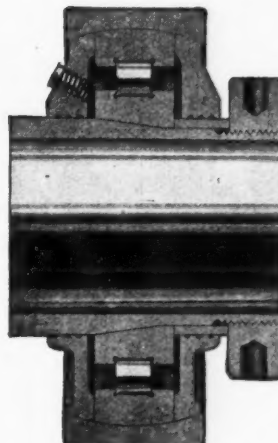
Equipped with clamping sleeve and nut, and provided with side plates for protection from dirt and moisture. Made to inch dimensions in light and medium series.



"RSW" TYPE

Self-aligning

Equipped with side plates for protection from dirt and moisture. Made to inch dimensions in light and medium series.



Our engineers will welcome an opportunity to work with yours, in the application of these high-duty precision bearings with a view to securing maximum anti-friction efficiency.

THE NORMA COMPANY OF AMERICA

Anable Avenue

Long Island City

New York

Manufacturers of "NORMA" Precision Ball Bearings

THE GROWING IMPORTANCE OF *Lubrication* IN THE PUBLIC MIND



From practically every state we are getting constant reports of a rather startling increase of public interest in the question of lubrication.

The news of the remarkable savings made in repair costs by fleet owners through the methodical use of ALEMITE is spreading rapidly to the passenger car owner.

From a handy-man's job, lubrication has grown to be the biggest source of side-revenue for hundreds of garages and service stations. In one small town last year one dealer made \$5,000 lubricating cars with ALEMITE. He has over 300 customers who have subscribed to a regular monthly lubricating service.

Car dealers, too, report this year, that in discussing upkeep costs an unusual proportion of purchases have hinged upon lubrication equipment—especially where the prospect is buying his second or third car.

THE BASSICK MANUFACTURING COMPANY
2656 N. Crawford Ave., Chicago, Ill.

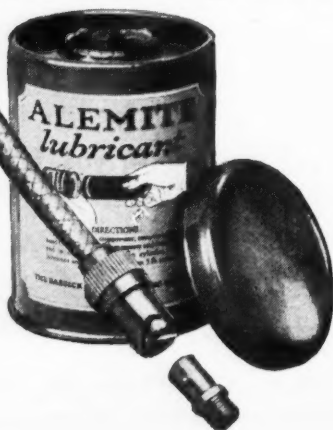
Canadian Factory: Alemite Products Company of Canada, Ltd., Belleville, Ontario

ALEMITE

High Pressure Lubricating System

Oil or Grease

The ALEMITE HIGH-PRESSURE LUBRICATING SYSTEM can be used with either oil or grease. But we recommend ALEMITE LUBRICANT, because it is a solidified oil which we have perfected especially for our System. It has all the benefits of oil, but at the same time is sufficiently solid to "stay put."



A Bassick
Alemite
Product

—concerning the Bearing Division of the Ryerson Corporation

PERHAPS Joseph T. Ryerson & Son, Inc., are best known as a Steel-Service organization — a reputation built up thru more than eighty years of business.

A number of years ago the Bearing Division was organized with its own bearing factory and babbitt plant. Special processes of manufacture, developed thru engineering research, necessitated the construction of special machinery and equipment.

The aim—to produce a superior product worthy of the Ryerson name and reputation—a bearing that engine builders would consider an asset to their motors.

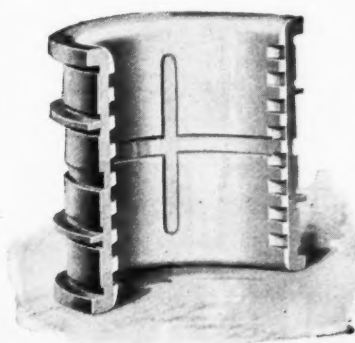
The result—many leading motor manufacturers have adopted and are using Ryerson Superior Bearings year after year.

Not only "best by test" but also "best thru service."

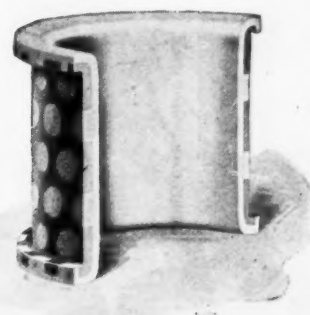
JOSEPH T. RYERSON & SON INC.

ESTABLISHED 1842

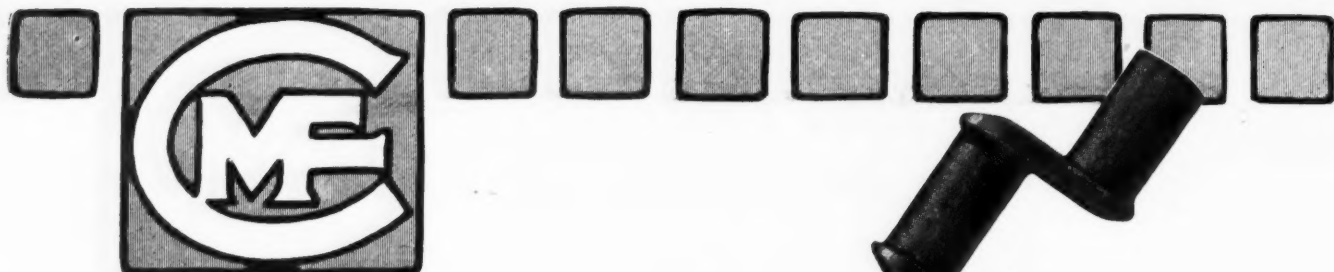
CHICAGO ST. LOUIS CINCINNATI DETROIT BUFFALO NEW YORK
BRANCH OFFICES: DENVER HOUSTON JERSEY CITY
MILWAUKEE MINNEAPOLIS NEWARK SAN FRANCISCO TULSA



RYERSON "Superior" BEARINGS



CHAMPION



There is nothing you can do that will so readily prove that a forging is something more than a piece of hammered steel or that all forgings are not alike, as reference to your own cost records. Even a casual reference to your own cost sheets will provide a surer, sounder means of achieving economy in buying than hours of argument or price dickering.

Do this when the next order for drop forgings comes up. Then, perhaps, the fact that Champion Drop Forgings do require less machining and finishing, less tool or machine adjusting, fewer operations may induce you to put their accuracy to blueprint specifications, uniformity of metal and alignment to a practical test.

THE CHAMPION MACHINE & FORGING CO.
3695 East 78th Street, Cleveland, Ohio

New York Office: 30 Church St.
Philadelphia Office: Bourse Bldg.
Detroit Office: 705 Ford Bldg.

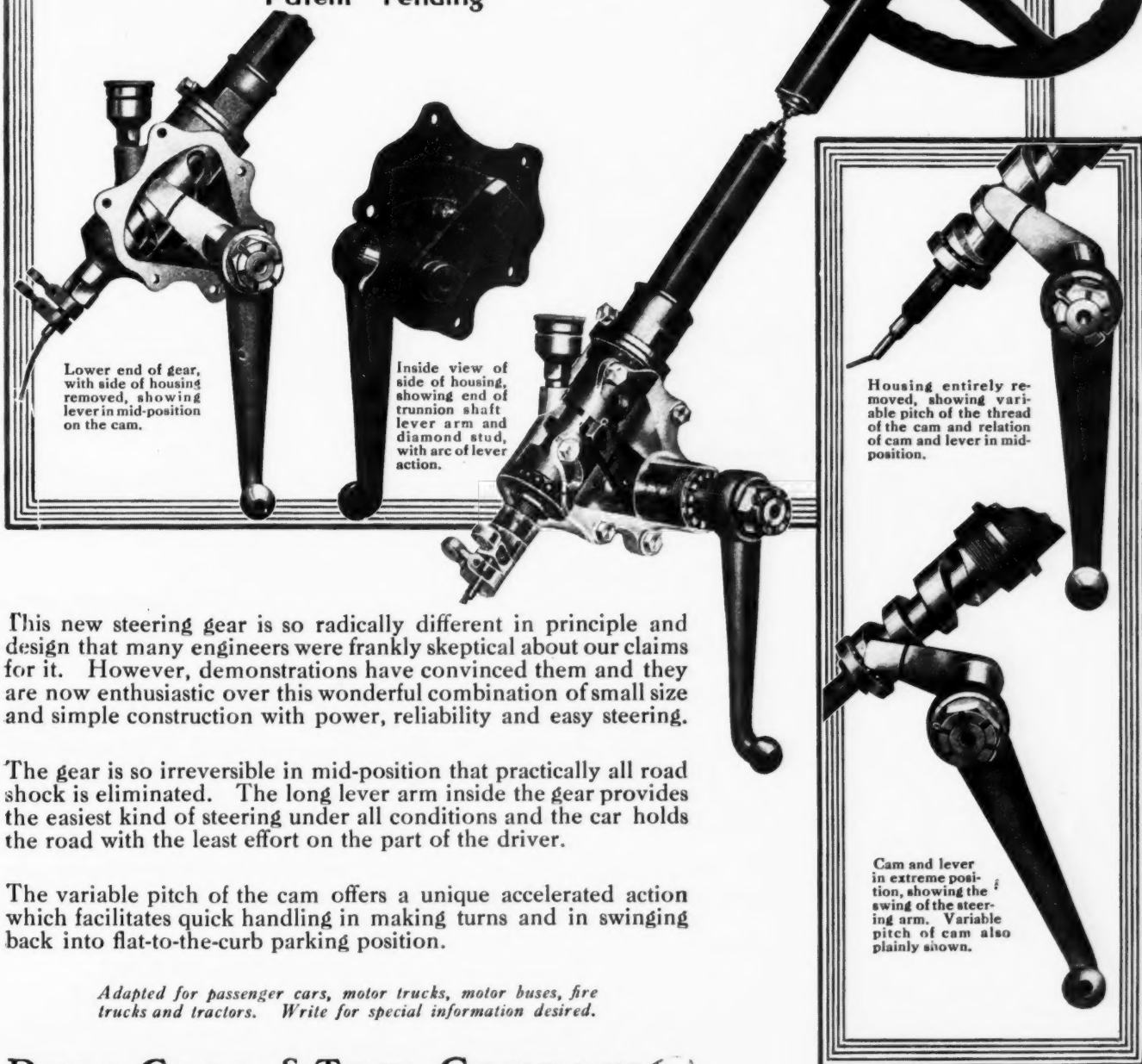


DROP FORGINGS

ROSS

Cam & Lever Steering Gear

Patent Pending



Lower end of gear, with side of housing removed, showing lever in mid-position on the cam.

Inside view of side of housing, showing end of trunnion shaft lever arm and diamond stud, with arc of lever action.

Housing entirely removed, showing variable pitch of the thread of the cam and relation of cam and lever in mid-position.

Cam and lever in extreme position, showing the swing of the steering arm. Variable pitch of cam also plainly shown.

This new steering gear is so radically different in principle and design that many engineers were frankly skeptical about our claims for it. However, demonstrations have convinced them and they are now enthusiastic over this wonderful combination of small size and simple construction with power, reliability and easy steering.

The gear is so irreversible in mid-position that practically all road shock is eliminated. The long lever arm inside the gear provides the easiest kind of steering under all conditions and the car holds the road with the least effort on the part of the driver.

The variable pitch of the cam offers a unique accelerated action which facilitates quick handling in making turns and in swinging back into flat-to-the-curb parking position.

Adapted for passenger cars, motor trucks, motor buses, fire trucks and tractors. Write for special information desired.

ROSS GEAR & TOOL COMPANY
700 Heath St., Lafayette, Indiana, U.S.A.

ROSS STEERING GEARS

THE STEERING GEARS THAT PREDOMINATE ON MOTOR TRUCKS

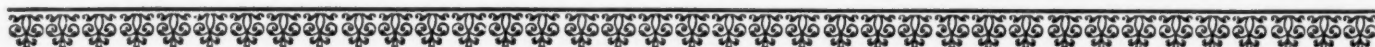


Beauty wields its selling wand *in Closed Cars*



BEAUTY has cast its spell since the day the world began, and beauty will cast its spell until Doomsday. It is the nature of man first to concern himself with fundamentals — then add to fundamentals the witchery of beauty. Utility first, then beauty. Necessity, then luxury. Man works that he may eat; but works harder that he may eat with silver, from fine china, and clothe his body in richest silks and fleece and flax. It is the nature of man forever to covet the niceties and refinements of life.

The automobile began as a vehicle and has become an equipage. It was inevitable, foreordained by the law of human desire. First mechanical excellence; then beauty and luxury: classic coachwork; glass windows; velour interiors, yielding as eiderdown. Today elegance is a major selling influence.



The Requiem of "Hardware"

The Dura Company has watched this evolution of closed car style through all the years it has been developing window regulators. Interior embellishments known to the industry as "hardware" no longer meet ideals of beauty and good taste. Ordinary closed car "hardware" is more than ever just hardware. And hardware will not do.

A new day is here. The Dura Company has designed and produced for closed car interiors a complete assortment of utility ornaments that reflect an entirely new standard of artistry. These are known as Dura Fittings. To closed car builders and buyers alike Dura Fittings fulfill every wish as to beauty and decorum. There is nothing like them.

The Selling Power of Details

The time has come when the trimmings and trappings of closed car interiors assume genuine importance as selling features. Certainly beauty outsells every time.

We sincerely believe that the public will welcome the advent of Dura Fittings as the beginning of a new era in closed car elegance. And we suggest the importance to manufacturers of discussing Dura Fittings with us before deciding future production requirements.

THE DURA COMPANY, *Toledo, Ohio*



The Famous Blades produced by the Armors of Damascus during the Sixteenth Century were the results of surprising skill, great patience and much experiment.

The Blades were much sought after by the adventurous gentlemen of that period and were prized for their toughness, spring and absolute reliability.

Like The Trade Guilds of The Middle Ages

In the strict supervision of the product of its members and the high standards of quality that must be met before a member's castings can be marketed as "Certified Malleable," the work of The American Malleable Castings Association parallels the activities of The Trade Guilds of the Middle Ages.

- (a) Improvement of malleable iron through research.
- (b) The dissemination of accurate information to the trade.
- (c) The guardianship of consumers' interests are the sole functions of this Association.

Like the old guilds, the Association sees that its member foundries conform to adopted standards of material and workmanship; while strict supervision and close inspection by the Association's Consulting Engineering Department is accepted by critical buyers of malleables as an absolute guaranty of quality.

Through Association research the tensile strength of malleable iron has been increased from 38,000 to 50,000 pounds per square inch, and elongation from 5 per cent to 10 per cent. Other valuable properties, such as uniformity, soundness, rust resistance, and easy machining have shown even greater improvement. Today Certified Malleables are a guarantee of positive and dependable physical properties in vital parts of all classes of machinery.

THE AMERICAN MALLEABLE CASTINGS ASSN.
The 1900 Euclid Building Cleveland, Ohio

MAKERS OF CERTIFIED MALLEABLE CASTINGS

Certificate Holders for the Quarter Ending December 31st, 1922

Albany Malleable Iron Co.	Voorheesville, N. Y.
Albion Malleable Iron Co.	Albion, Mich.
American Malleable Castings Co.	Marion, O.
American Malleables Co.	Lancaster, N. Y., and Orono, Mich.
Badger Malleable & Mfg. Co.	South Milwaukee, Wis.
Baltimore Malleable Iron & Steel Casting Co.	Baltimore, Md.
Belle City Malleable Iron Co.	Racine, Wis.
Chain Belt Co.	Milwaukee, Wis.
Chicago Malleable Castings Co.	West Pullman, Chicago, Ill.
Columbus Malleable Iron Co., The	Columbus, O.
Denville Malleable Iron Co.	Denville, Ill.
Dayton Malleable Iron Co.	Dayton, O., Ironton, O., and Canton, O.
Decatur Malleable Iron Co.	Decatur, Ill.
Devin Mfg. Co., Thomas	Philadelphia, Pa.
Eastern Malleable Iron Co., The	Naugatuck Malleable Iron Works, Bridgeport, Conn.
Bridgeport Malleable Iron Works, Bridgeport, Conn.	Troy Malleable Iron Works, Troy, N. Y.; Wilmington Malleable Iron Works, Wilmington, Del.; Vulcan Iron Works, New Britain, Conn.
Erie Malleable Iron Co.	Erie, Pa.
Federal Malleable Co.	West Allea, Wis.
Flagg & Co., Stanley O.	Philadelphia, Pa.
Fort Pitt Malleable Iron Co.	Pittsburgh, Pa.
Fraser & Jones Co.	Syracuse, N. Y.
General Electric Co.	Erie, Pa.
Illinois Malleable Iron Co.	Chicago, Ill.
Iowa Malleable Iron Co.	Fairfield, Ia.
Kalamazoo Malleable Iron Co.	Kalamazoo, Mich.
Laconia Car Co.	Laconia, N. H.
Lakeside Malleable Castings Co.	Racine, Wis.
Link-Belt Co.	Indianapolis, Ind.
Marion Malleable Iron Works	Marion, Ind.
Moline Malleable Iron Co.	St. Charles, Ill.
National Malleable Castings Co., The	Cleveland, O., Chicago, Ill., Indianapolis, Ind., Toledo, O., E. St. Louis, Ill.
Northern Malleable Iron Co.	St. Paul, Minn.
Northwestern Malleable Iron Co.	Milwaukee, Wis.
Pennia Malleable Castings Co.	Pooria, Ill.
Pittsburgh Malleable Iron Co.	Pittsburgh, Pa.
Rhode Island Malleable Iron Works	Hillsgrove, R. I.
Rockford Malleable Iron Works	Rockford, Ill.
Rose-Meehan Foundries, The	Chattanooga, Tenn.
St. Louis Malleable Casting Co.	St. Louis, Mo.
Saginaw Malleable Iron Co.	Saginaw, Mich.
Standard Malleable Castings Co.	Terre Haute, Ind.
Stowell Co., The	South Milwaukee, Wis.
Symington Co., T. H., The	Rochester, N. Y.
Temple Malleable Iron & Steel Co.	Temple, Pa.
Terre Haute Malleable & Mfg. Co.	Terre Haute, Ind.
Trenton Malleable Iron Co., The	Trenton, N. J.
Union Malleable Iron Co., The	E. Molitor, Ill.
Vermilion Malleable Iron Co.	Hoopeston, Ill.
Wagner Malleable Iron Co.	Hammond, Ind.
Warren Tool & Forge Co.	Warren, Ohio
Webster Mfg. Co., The	Chicago, Ill.
Wisconsin Malleable Iron Co.	Milwaukee, Wis.
York Mfg. Co.	York, Pa.
Zanesville Malleable Co.	Zanesville, O.



CERTIFIED-MALLEABLE CASTINGS

The Rollers in
GILLIAM Tapered
Roller Bearings are
contained within
a clean-cut, one-
piece, steel stamped
cage flanged in-
ward on the small
diameter, thus in-
suring rigidity and
durability.

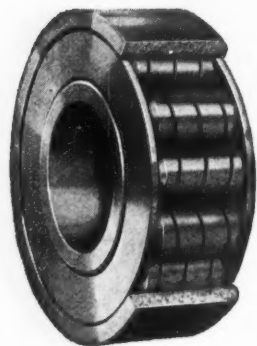
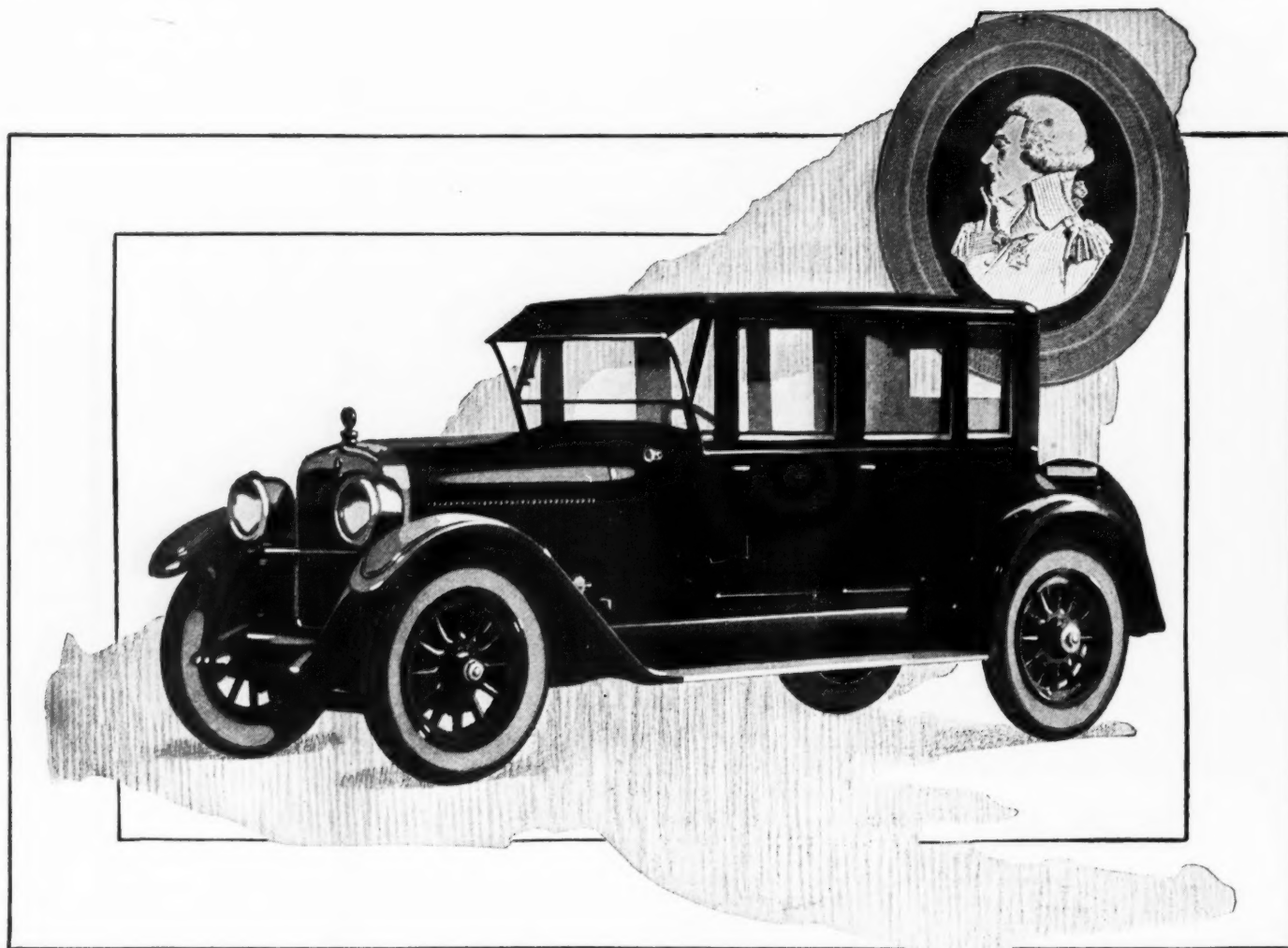
*Axle manufacturers using Gilliam
Tapered Roller Bearings include:
Adams, Clark, Columbia, Flint, Salis-
bury, Sheldon, Standard Equipment,
Torbensen, U S, Vulcan, Wisconsin.*



THE GILLIAM MFG. CO. - - Canton, Ohio

Cups, Cones, Rollers
ALLOY Steel
THROUGHOUT





THE La Fayette provides an excellent example of what can be accomplished in fine automobile building where quality of materials and precision of workmanship are held to rigid standards.

Hyatt roller bearings have again demonstrated to a quality car manufacturer the desirable results that are assured through the use of these bearings.

By building Hyatt bearings into the transmission an appreciable contribution has been made to the strength and quiet operation of the La Fayette car. They also help to give the driver that serenity of mind which comes of the knowledge that the mechanical construction of his car is dependable—always.

HYATT ROLLER BEARING COMPANY

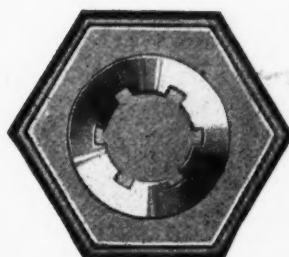
Newark	Detroit	Chicago	San Francisco
Worcester	Milwaukee	Huntington, W. Va.	Minneapolis
	Cleveland	Pittsburgh	Indianapolis
		Buffalo	Philadelphia

HYATT

Quiet
Roller Bearings

LANCASTER

Cold Finished
STEEL



Clutch Disc



Diaphragm



Clutch Spring



Valve Spring



Piston Pin

COLD DRAWN WIRE & BARS
(Carbon and Alloy)

Screw Stock

(Open Hearth and Bessemer for Screw
Machine Parts—S. A. E. Specifications.)



Connecting Rod Bolt

COLD ROLLED STRIP

Any Analysis

Any Temper



Shock Absorber Spring



LANCASTER STEEL PRODUCTS CORPORATION
PHILADELPHIA, PA. U.S.A.

NEW YORK
PHILADELPHIA

HARTFORD
BUFFALO

BOSTON
DETROIT



Brake Band



Automobile Body Stampings

THE roster of Hayes Manufacturing Company customers reads like a Blue Book of the whole Automotive Industry.

To serve the leaders in this industry calls for high grade production only—for the better automobile makers are tolerant of everything except laxity.

It can serve your organization—in the rapid and accurate production of Body Stampings, Fenders, Hoods and other Standard or Special Sheet Metal Parts. Send your blue prints—estimates furnished quickly.

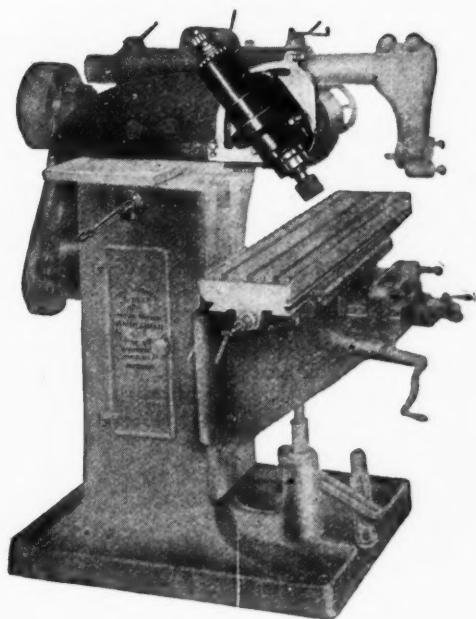


Hayes Manufacturing Company

Detroit, Mich.



You Can Steer the Van Norman Duplex



If a car had no steering wheel, so that it could only run in one direction, its usefulness would be exceedingly limited, wouldn't it?

The difference between an ordinary milling machine and the Van Norman Duplex is just as great.

The cutter head of the Van Norman Duplex is quickly adjusted to cut at any angle through 90 degrees; with sub head, through 270 degrees. The ram on which the cutter head is mounted is movable in and out over the column.

A great variety of work—angular, right angular or curved—can be handled on the Van Norman with a simple right angle end milling cutter and but one clamping of the work. The cutter is easily placed in the most advantageous position and any cut carried *through the full movement of the table.*

The unusual flexibility of the Van Norman Duplex makes it a big time and money saver in your toolroom.



SPRINGFIELD ~ ~ ~ ~ MASS.

Perfectly balanced!

The unique quarter-section construction of Van Metal wheels makes their perfect balance a certainty.

The quarter sections, beautifully cast and exactly alike with all unnecessary weight eliminated, form a wheel which is not only balanced and true but that is as light as a high grade wood wheel yet strong enough to withstand the hardest service.

The Van is the modern truck wheel—the economical truck wheel. Its capacity for service is exceedingly high. No Van wheel has ever failed on the job.

Good looking with smooth, rounded surfaces for easy cleaning, it takes a handsome finish.

Built in practically all sizes from 30 x 3½ for Fords to 40 x 14 for heavy solid tired trucks—and taking standard wood wheel hub equipment.

Write for complete details.

VAN WHEEL CORPORATION
Oneida, New York

VAN METAL WHEELS



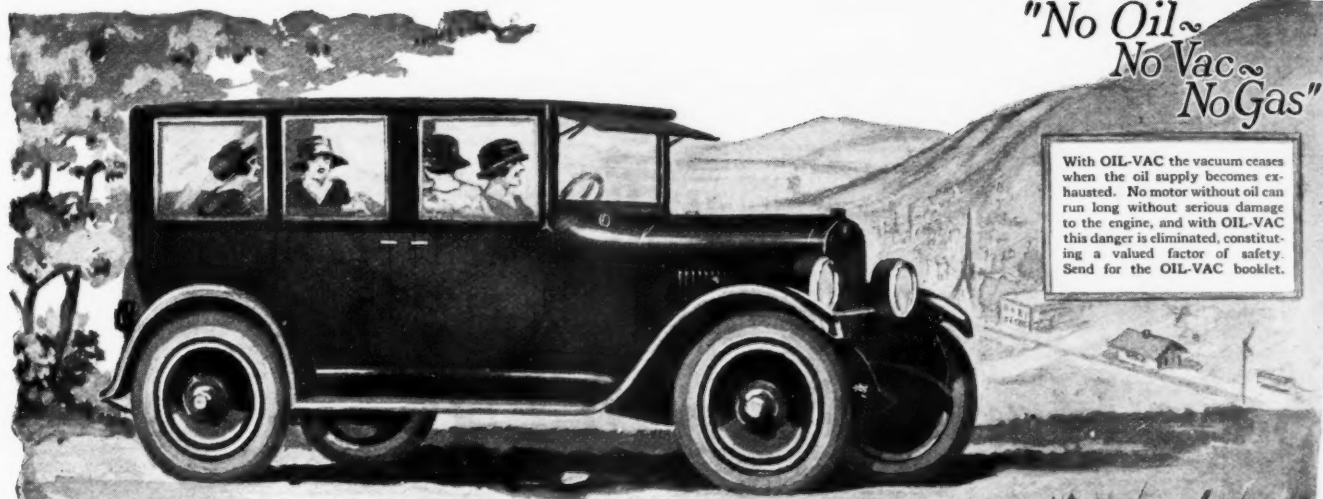
Made in Quarter Sections

Each Van Wheel is made up of four castings which are tongued and grooved at the joints and riveted together.

These quadrant castings are alike in size, shape and weight, thus forming a balanced wheel even in the rough and one that is concentric and true.

Castings in quadrants means better castings with walls of uniform thickness and no unnecessary weight. With hollow spokes, widening at the hub where the strain is greatest, the complete wheel has no weak spot that can possibly fail in service.

Of high grade, soft, malleable iron, tough and resilient, Van Wheels stand up under road shocks without crystallization—though light they have an unmatched margin of strength and durability.



"No Oil~
No Vac~
No Gas"

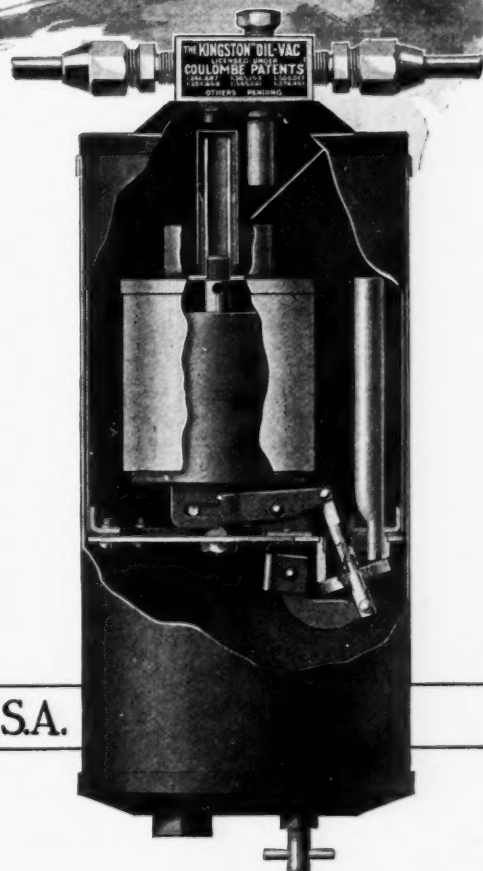
With OIL-VAC the vacuum ceases when the oil supply becomes exhausted. No motor without oil can run long without serious damage to the engine, and with OIL-VAC this danger is eliminated, constituting a valued factor of safety. Send for the OIL-VAC booklet.

The Good Maxwell uses Kingston "Oil-Vac" —

The beauty of the new Maxwell is marked. The excellence of the car is everywhere acknowledged. And the newest and handsomest of the Maxwell line has OIL-VAC as standard equipment.

Maxwell engineers insisted that only the best should go into the car. Every part was subjected to the severest tests, and only those products that met these rigid requirements were accepted. OIL-VAC is a new and better principle. It does away entirely with the intake manifold as a suction source. It utilizes instead the suction produced by the proper proportioning of the oil circulating pump. With this system there is certainty of increased suction with increased engine speed—when the greatest amount of fuel is needed, as on long grades or at high speeds, the greatest amount is actually being delivered to the motor. Disturbance of carburetion is at a minimum, dilution in the crank case is lessened to a marked degree, oil runs cooler and lubrication is more efficient.

A Car Equipped with Oil-Vac is a Better Car



BYRNE, KINGSTON & CO. KOKOMO, IND., U.S.A.

New York, 245 West 55th Street
Chicago, 1430 Michigan Avenue

BRANCHES:

Los Angeles, 1417 S. Pico

Detroit, 7644 Woodward Avenue
Boston, 15 Jersey Street

Dallas, 2218 S. Harwood Street

"Oil-Vac"



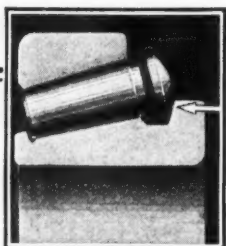
Says Harry Stutz to Us:



"Your product has given us entire satisfaction, as we have only had two cases of any trouble whatsoever in the past three years, using your bearings at various places in our car, and in these two instances, the trouble was due to the mechanic adjusting the bearings too tight."

The above is a quotation from an unsolicited letter written to The Bock Bearing Company, by Harry C. Stutz, under date of April 16th, 1923.

THE BOCK BEARING COMPANY
TOLEDO, OHIO

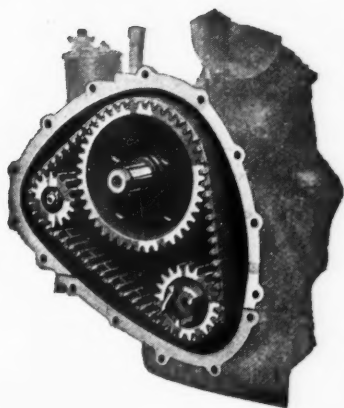


The round head roller, found only in Bock Bearings, results in less friction and longer service.

BOCK

Quality TAPER ROLLER
BEARINGS

**During the Month
of May 3300
Cars Per Day were
equipped with-
MORSE CHAINS
and that number
is Daily Increasing**



THE CONSTANT PRESSURE ANGLE CHAIN

MORSE

GENUINE SILENT CHAIN





“Careful Please”

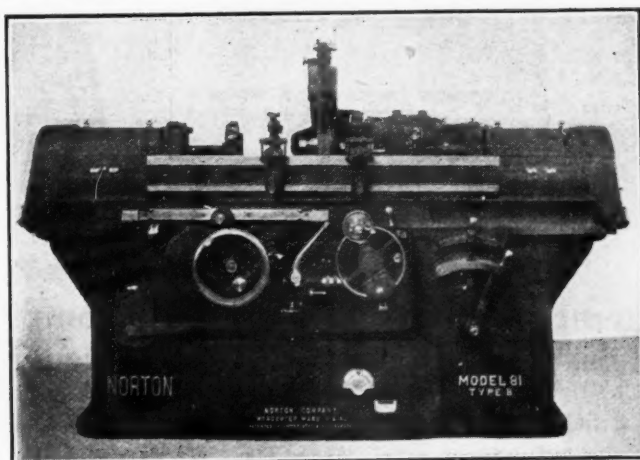
The wide flexibility of the Klaxon note provides a range of sound that rivals infinite gradations of the human voice. One minute it may speak a gentle, courteous note of caution; in the next it shrieks a sudden warning.

*“A Good Horn is Safety Insurance
Only Klaxon Quality is Good Enough”*

Genuine KLAXON Horns made only by

KLAXON

Company · Newark, N. J.



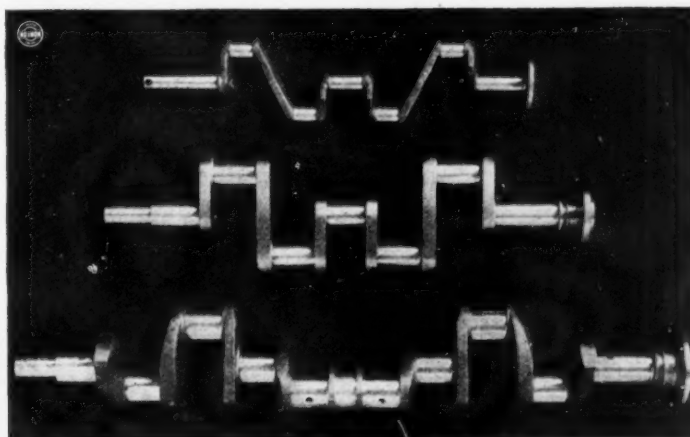
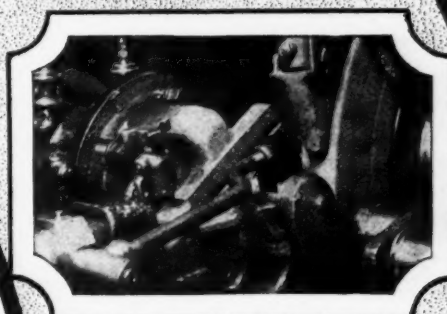
HIGH SPEED production without sacrifice of accuracy limits is a characteristic of all NORTON production-precision grinding machines; and this applies especially to the new **Model 81, Type B Crankpin Grinding machine**. It is made in four sizes all having 14" swing and taking work from 24" to 48" in length.

The machine will accommodate every conceivable type of crankshaft within its capacity, from the light four-cylinder type shown to the heavy six-cylinder shafts. The machine is equipped with the well known NORTON B-Type features which assure rigidity, ease of adjustment, convenience of operation, high production, accuracy and safety.

NORTON COMPANY

WORCESTER, MASS.

M-88



A File for Every Purpose



The Right File for the Job

IT'S as hopeless to attempt to get along without a complete ASSORTMENT of Files as with too few sizes of wrenches.

One up-to-date service station in New York City purchased the following files for their own use in a single year:

- | | |
|------------------------------------|--------------------------------------|
| 10—10 in. flat bastard files | 7— 8 in. half-round second cut files |
| 1—12 in. flat smooth file | 9—12 in. half-round bastard files |
| 7—14 in. flat bastard files | 7—14 in. half-round bastard files |
| 1—14 in. flat second cut file | 1—14 in. half-round second cut file |
| 16—16 in. flat bastard files | 1—12 in. round bastard file |
| 1—16 in. flat second cut file | 1—12 in. square bastard file |
| 12— 8 in. half-round bastard files | 6—12 in. mill bastard files |
| 1—10 in. three square bastard file | |

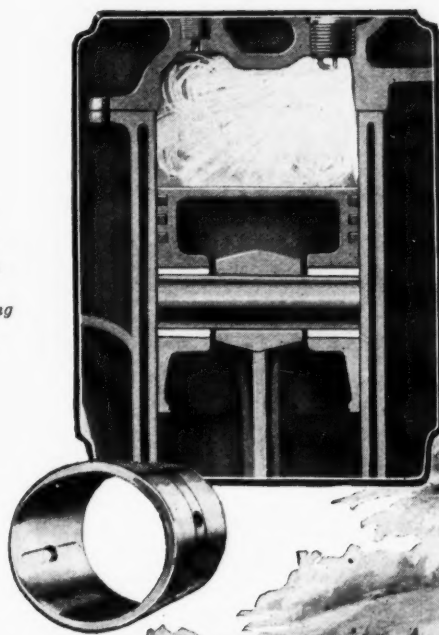
Only with the RIGHT tools to work with, should your mechanics be held responsible.

With the name "NICHOLSON" on the tang of every file in your shop, they'll gladly shoulder their responsibilities.

Ready-sharp from the first stroke, edgeholding and enduring—Nicholson Files have earned the supreme confidence of men who know good tools. And there's a Nicholson File (or Rasp) for every purpose.



A
Worn
Piston
Pin
Bushing



The quality of the bushings has much to do with the performance of the car you build

A PISTON pin knock or a spring bolt rattle will ruin the reputation of a car that is one hundred per cent good in other and perhaps more important details. The bronze bushings in any car represent an infinitesimal fraction of its cost, but a big percentage of its performance value.

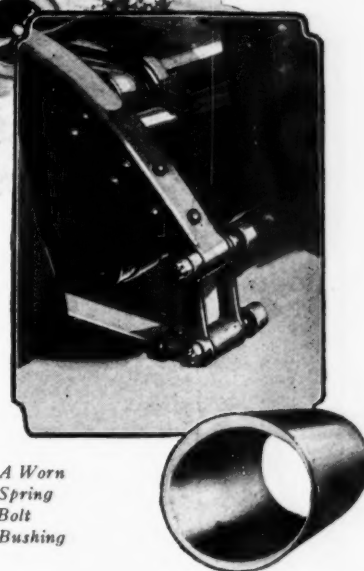
Bunting Bushings in automotive mechanisms are accepted by trade and public as an evidence of the car builder's determination to

employ only the best in the making of his product.

Bunting has the factory equipment and experience to produce any bronze bushing bearing your need may demand.

Most of your requirements can be supplied from Bunting's list of "Ready Made" bronze bushings. This list includes 268 different sizes of completely finished bronze bushings ready for assembly. "They're always in stock" ready to ship. Long run prices even on small lots. Write for Stock List Y

A Worn
Spring
Bolt
Bushing



For your special order lines Bunting has pattern and tool equipment for over 10,000 different designs and practically unlimited foundry and machine shop capacity.

THE BUNTING BRASS & BRONZE COMPANY
Toledo, Ohio



New York
245 West 54th St.
Circle 0844

Boston
36 Oliver St.
Main 8488

Chicago
722 S. Michigan Ave.
Wabash 9153

Cleveland
710 St. Clair St., N. E.
Main 5991

San Francisco
198 Second Street
Douglas 6245



BUNTING BUSHING
BEARINGS
PATENTED

As You Want It

Interstate Refined Open Hearth Alloy Steels are manufactured to standard specifications or to your own.

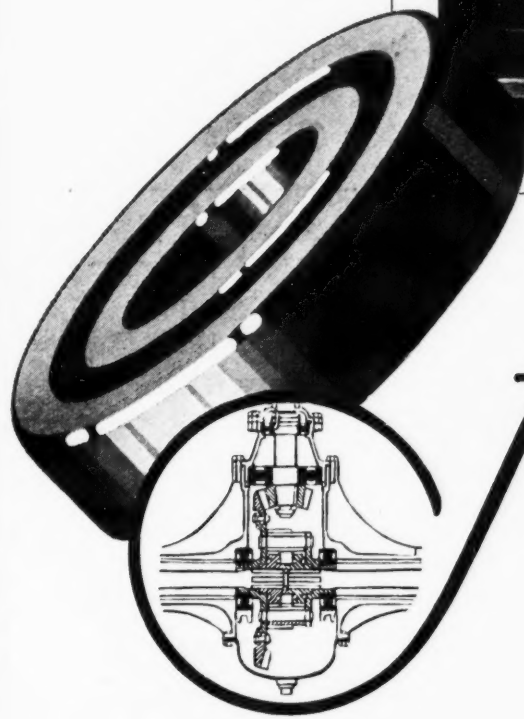
The constant precision in every step of the manufacture would please you, were you to follow your order from the charge to the shipping platform.

The result is good—the product will serve you well.

*Open Hearth Alloy Steel Ingots, Billets, Bars
Wire Rods, Wire Nails, Rivets and Cut Tacks
Iron Bars and Railroad Tie Plates*

INTERSTATE IRON & STEEL CO.
104 South Michigan Avenue
CHICAGO

Interstate Steels



BEARINGS

for every application

Radio Thrust Bearings
for wheels differentials
pinion shafts and all
other applications carried
in stock at each of our
37 Branches. This is but
one of the lines carried
at our branches to give you
PROMPT SERVICE.

BRANCHES

In thirty-seven cities!

**AHLBERG
BEARING
COMPANY**

321 East 29th St. Chicago

Cost of Reputation

The amount of money spent by this company in advertising, has invariably been overestimated by those unacquainted with the figures.

There are good reasons for this in the fact that Timken publicity has been consistent and long-continued; and still more in the fact that Timken Axles have verified the conservative statements of Timken.

It is not by brilliant advances and sharp retreats but by the steady progress of twenty years—a new idea here, a little added quality there, a constant forward development of axle design—that the name Timken has identified itself with dependability.

Thus factory vigilance and advertising truthfulness have together worked a reduction in selling cost both for us and for Timken-equipped cars.

The use of Timken Axles by car builders who had for years built their own axles proves not only Timken reputation but also the reasonable cost of that reputation.

THE TIMKEN-DETROIT AXLE COMPANY, DETROIT, MICH.

Sole Representatives in the British Isles:

AUTOMOTIVE PRODUCTS COMPANY, 3, Berners Street, London, W. 1.



Magazine advertising is economical and productive in proportion as it is supported by the word-of-mouth advertising of the buyers.

Engineering

must combine mechanical with economic satisfaction.

We cast this thought in bronze.



A specialized, hard cast bronze possessing remarkable resistance to wear. The best heavy duty bearing wherever a hard bronze can be used. Finished Parts, Castings, Solid and Cored Bars.

A. B. C. Alloys

A series of cast bronzes meeting all recognized specifications.

Each is adapted to a specific duty where mechanical or economic reasons do not permit the use of NON-GRAN.

Finished Parts, Castings, Solid and Cored Bars.



Finished bushings, steel jacketed and lined with a hard, wear-resisting, rolled bronze. In spring suspension duties, assembly reaming or broaching costs are eliminated.

—Purchasing Agent

Full information on Non-Gran bronze and Armor bushings should be in your bushing files. We will be glad to furnish complete data specially arranged for quick consultation.

—Engineers, Designers

Specifications and service data on bearing metal for any indicated duty will be assembled especially for you on request. We may have facts that will save you time and research effort.

AMERICAN BRONZE CORPORATION

Plain bearing Engineers and Manufacturers of Non-Gran bearing bronze

Berwyn

Pennsylvania

If anyone is competent to speak with authority on the subject of bearings and bearing metals, it is Mr. Louis Chevrolet, President of the Frontenac Motor Company, manufacturers of the famous Frontenac Racing Cars.



FRONTENAC
MOTOR COMPANY
LOUIS CHEVROLET, PRESIDENT
INDIANAPOLIS, IND. U.S.A.

February 24th, 1923.

Muzzy-Lyon Company
Detroit, Michigan.

Attention Mr. David W. Rodger.

Gentlemen:

Answering your inquiry about the connecting rods which you lined for us with Mogul Metal for our racing cars, would say that they behaved splendidly and as far as we know they will keep on doing so, as after quite a bit of running they do not show any wear and we certainly expect to see them last a long time.

The conditions under which those bearings have to work is rather unusual except on racing motors, where they are subject to a very high bearing pressure and very high heat, as we turn those racing motors above 4000 R. P. M.

Yours very truly,

Louis Chevrolet

The above refers to the "Mogul Alloy Genuine" special connecting rod metal which he has used for years in Frontenac Racing Cars.

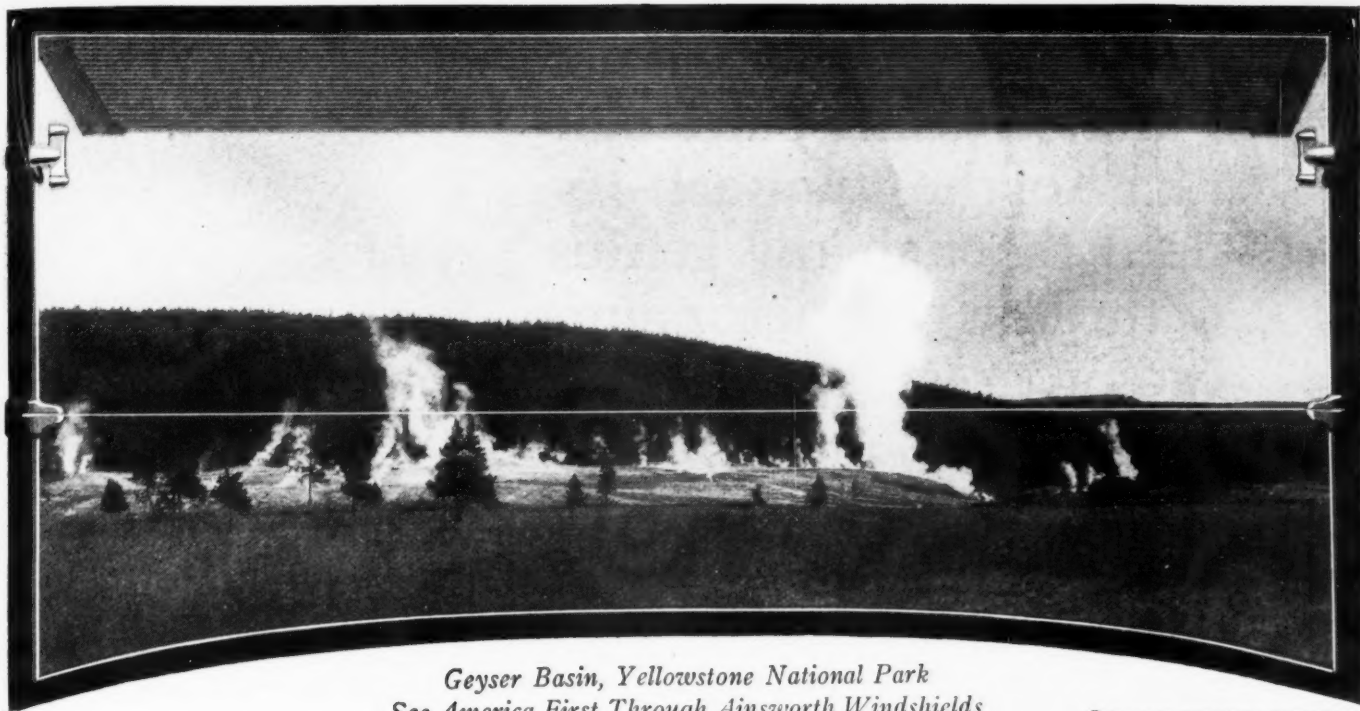
Mogul metal will far outwear the average bearing alloy. It will babbitt more rods per pound, produces a uniform bearing of very fine grain without troubles from shrinkage or blow-holes, and is very easily poured.

Write for a copy of "Mogul Alloys for Better Bearings" or better still, order a trial box today.

MUZZY-LYON COMPANY
Detroit -:- Michigan

Mogul

Engine Bearings and Bearing Alloys



*Geyser Basin, Yellowstone National Park
See America First Through Ainsworth Windshields*

© HAYNES, NORTHERN PACIFIC RY.



TOURING

The picture ahead of you is never impaired when your car is equipped with an Ainsworth Windshield and Visor.

Good weather or bad, the driver of a car on tour welcomes the comfort, convenience and safety of perfect vision afforded by the Ainsworth Windshield and Visor on his car.

This year thousands of tourists will receive the full measure of pleasure from their trips because of an Ainsworth equipped car.

The **Ainsworth**
WINDSHIELD AND VISOR

AINSWORTH MANUFACTURING COMPANY
DETROIT, MICHIGAN

WRIGHT experience is not limited to any particular phase of the flying art. Indeed through the genius of the Wrights, aeronautical progress received its original impetus.

Originally conceived in leadership in both plane and engine design and production, the present Wright organization continues in practice today the heritage so firmly established 20 years ago.

WRIGHT AERONAUTICAL CORPORATION
Paterson, New Jersey, U. S. A.

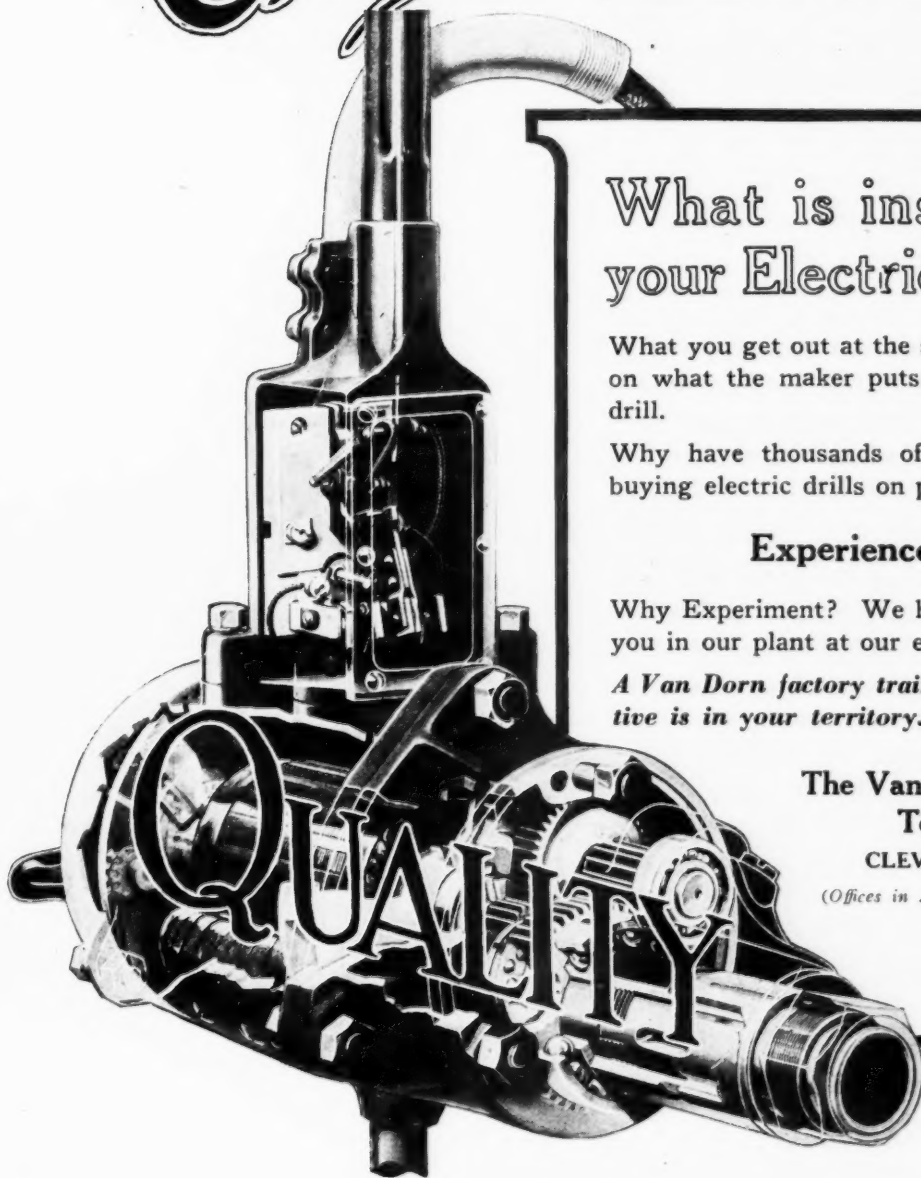


"The
Identification of
Incomparable
Service"



W R I G H T

Why Experiment? Use "Van Dorn" ELECTRIC DRILLS & GRINDERS



What is inside of your Electric Drill?

What you get out at the spindle depends on what the maker puts inside of your drill.

Why have thousands of users stopped buying electric drills on price?

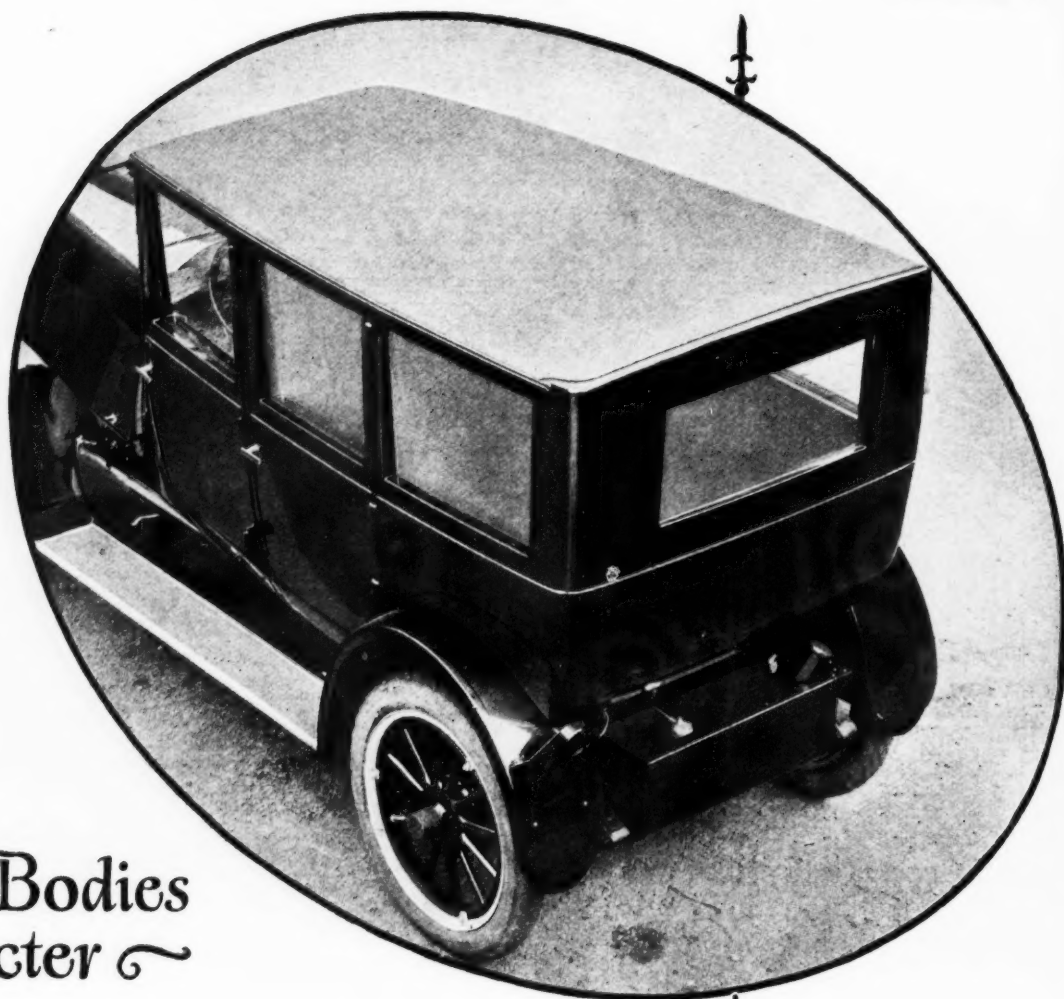
Experience—

Why Experiment? We have done it for you in our plant at our expense.

A Van Dorn factory trained representative is in your territory. Consult him.

**The Van Dorn Electric
Tool Co.
CLEVELAND, O.**

(Offices in All Principal Cities)



Raulang Bodies of Character ~

The Baker R & L Company is a body plant free from affiliations specializing in the making of closed bodies exclusively for the trade. This concentration of manufacture has resulted in a standard quality and workmanship at a medium price that was found heretofore only in higher priced bodies.

Our ample financing and stability insure our faithful performance of any contract; and our quantity production facilities, at least a thousand bodies per month, enable us to effect manufacturing economies that are reflected in our notably moderate prices. As a result, RAULANG Closed Bodies are found on many medium priced cars.

A RAULANG Body helps sell the car, because the salesman can point out those frequently unseen values of reserve strength and endurance that add to the comfort and to the silent operation of the car—not to mention the greater resale value.

Car Manufacturers

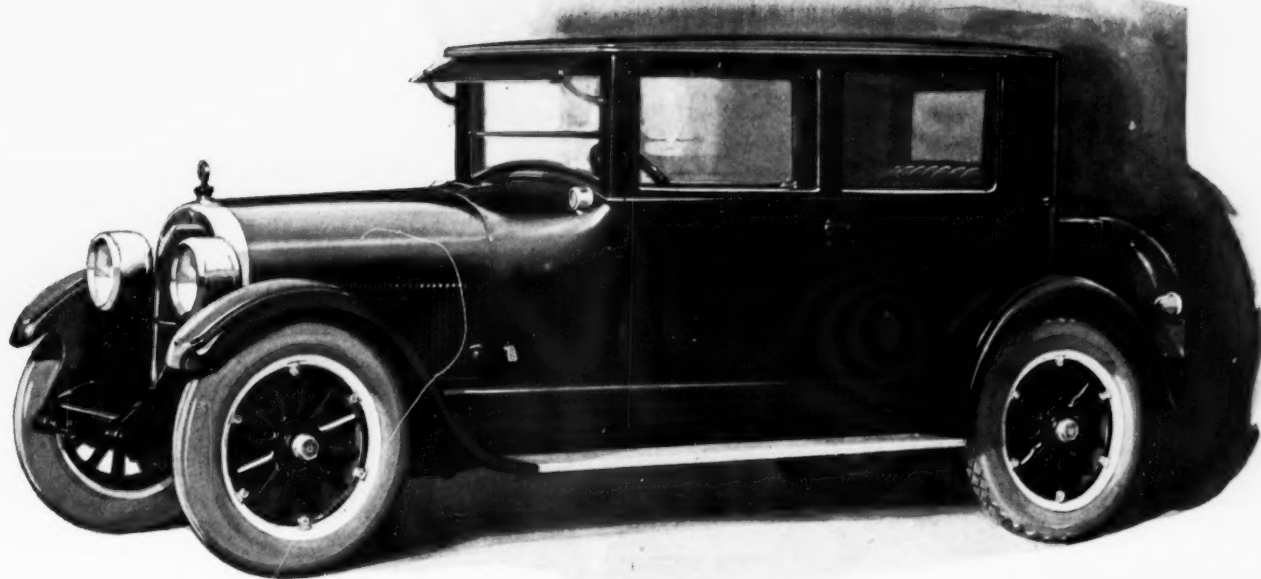
Let us do some "close figuring" on your closed body requirements.

RAULANG BODY DIVISION
The Baker R & L Co.
CLEVELAND, OHIO. U.S.A



PEERLESS

A New and Splendid Embodiment
of the Eight-Cylinder Principle



Peerless is being widely and swiftly recognized as a truly great eight-cylinder car because all of the resources of its great plant, and all of its advantages for minute precision and accuracy, are dedicated to that end.

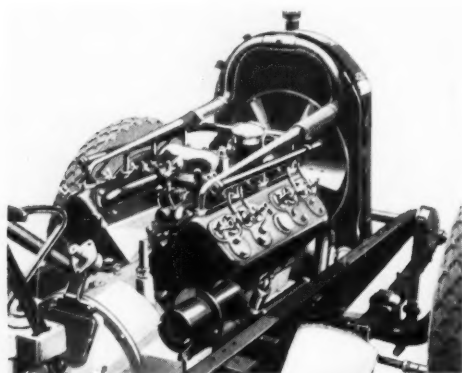
No endorsement of Whitman & Barnes could be more emphatic or complete, than the fact that "W & B" twist drills and reamers are worthy of contributing to the splendid quality for which Peerless has become so justly noted.

*The Whitman & Barnes Mfg. Co.
Akron, Ohio.*





For Peerless Precision and Accuracy



One step inside the Peerless factory and at once you sense the many things in which Peerless excels.

You instantly note a degree of care and scrupulous attention which Peerless gives to all details of manufacturing.

With regard to drilling and reaming operations—it is sufficient to say that, only the finest and best find a place in Peerless practice.

The fact that Whitman & Barnes twist drills and reamers have won and held the confidence and endorsement of Peerless is, we feel, the very highest compliment that could be paid.



"W & B" Warehouses

64 Reade Street, New York City
565 W. Washington St., Chicago, Ill.
139 Queen Victoria St., London, E. C. 4

Whitman & Barnes

AKRON, OHIO

Manufacturers of TWIST DRILLS AND REAMERS Exclusively



Patching a pan with cloth is not a permanent repair!

Remember how your grandmother used to cheat the tinsmith out of a job by plugging up the hole in her pan with a piece of rag? That was supposed to be a measure of economy but it was doubtful economy because the patch never stayed put more than a few weeks when the job had to be done all over again.

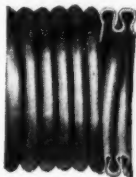
But the idea that a piece of cloth could make a tin pan hold water is no more scientific than the idea that a hose, with joints that have to be packed with fabric, could serve to carry gasoline.

NO. 2
OF A SERIES

Tite flex

REG. U. S. PAT. OFF.

Flexibility is obtained in ordinary metal hose by means of sliding joints which are packed to provide tightness.



Titeflex is of ALL-METAL construction and the flexibility is in the metal itself.

Titeflex is made from a profiled strip of metal helically wound into a convoluted tube having a double locked fixed seam at the top of each convolution.

The diaphragm action of the convolutions produces flexibility and absorbs vibration.

Titeflex is sturdy, flexible, inherently tight, heat resisting, and will not crystallize under vibration. Therefore, it is perfectly suited to the needs of the automotive manufacturer.



Commercially furnished with braided armored covering, either in random lengths or cut lengths, with or without couplings.

TITEFLEX METAL HOSE CO.

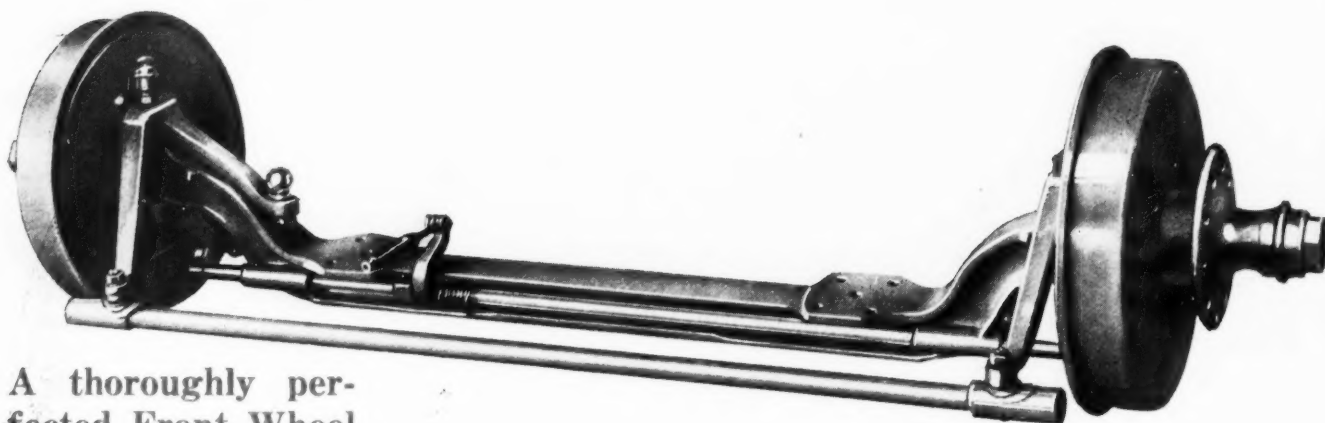
BADGER AVE. AND RUNYON ST.

NEWARK

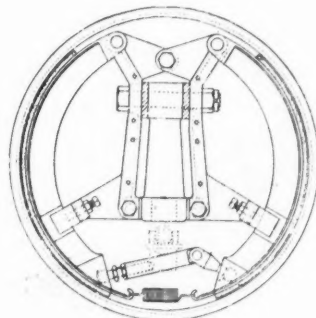
NEW JERSEY



Front Wheel Brake Axles m



A thoroughly perfected Front Wheel Brake Axle — that can be hooked up to and equalized with any conventional rear axle or transmission brake—is now available. Made by the Pioneers in this field of Automotive manufacture.



Simple in design. Effective and efficient in operation. Involving no large increase in production costs. Can be hooked up to and equalized with any conventional rear axle or transmission brake.

This axle is of the reverse Elliott type, with the usual I section at its center. The pivot pin is inclined and the Wheel Spindle is slanted downwards $1\frac{1}{2}^\circ$ from the horizontal, giving substantially center point steering.

An operating shaft, carried on the axle center, has threaded ends which move in internally threaded sleeves that force these sleeves in or out and actuate the brake mechanism.

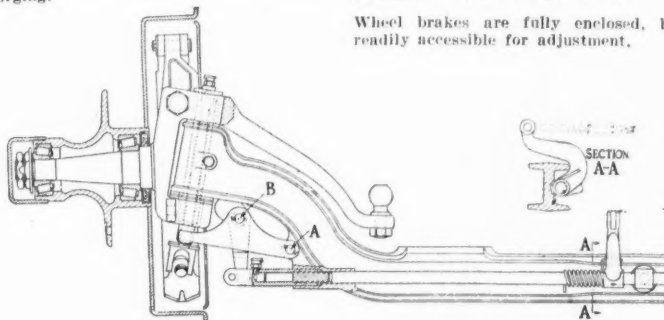
The brakes are of the two-shoe expanding type and are self-equalizing. The shoes are separately hinged to an anchorage, which is bolted to the knuckle forging.

The brake shoes are operated by means of a toggle at the bottom, which is in turn actuated by a yoke, the stem of which is fitted concentrically into the knuckle pivot pin and is free to rotate and slide axially therein.

Bearing against the yoke boss and straddling its stem is a lever pivoted at A on the axle center. This lever is operated by a second lever pivoted at B. The lower end of this second lever bears against a slot in the shaft sleeve referred to above.

The shaft and shaft sleeves are free to move longitudinally, which equalizes pressure on levers at both ends.

Wheel brakes are fully enclosed, but readily accessible for adjustment.



U.S. FRONT BRAKE

AXLES

s meet the need for Better Car Control

THERE are many sound reasons why so many car and truck manufacturers are now thinking of adopting four wheel brake equipment.

Present traffic conditions, both in the cities and in the highways have created a need for better car control. There is no possibility that traffic conditions will improve. It is inevitable that they will grow worse. But better car control can be secured and it is only logical that drivers and public alike should demand it.

Years of experimenting, designing and building of front wheel brake axles, has in many ways, prepared this company to meet the demand for this new and desirable form of better car control.

The U. S. Axle Company is building the axles for the first American car to use front wheel brakes as standard equipment.

The U. S. Front Wheel Brake Axle has been brought to the utmost simplicity consistent with satisfying performance. It can be adjusted to any stop limits desired.

It is not expensive. It is thoroughly tested by three years of performance. It is in use as regular equipment.

It is the last word on mechanical front wheel brake equipment and as such should claim the attention of all car manufacturers and engineers.

Complete details will be gladly furnished on request.

U. S. AXLE COMPANY, Pottstown, Penna.

U.S. FRONT

U S
FRONT WHEEL BRAKE
AXLES

BRAKE AXLES

EMPIRE BOLTS

*Russell,
Burdall
& Ward
accuracy
in every bolt*



*Over 75
years of
doing one
thing and
doing it well*

WHEN the automotive industry was in its infancy most of its sources of supply were uncertain and unstandardized. Yet, when it came to bolt and nut requirements it found one source of supply

where standards were over half a century old, where accuracy was a watchword and promises were sacred. Perhaps that is why most automotive engineers and manufacturers have continued to specify Empire Bolts & Nuts.

Most great institutions can truly be said to be as good as the rank and file of their employees. The closer an institution comes to being an organization of human beings bent on doing their utmost to make a perfect product the closer we come to a really great institution.

The spirit of Russell, Burdsall & Ward today is built on the spirit of generation after generation of loyal employees.



NICHOLAS FOX

Started April 13, 1856

67 Years

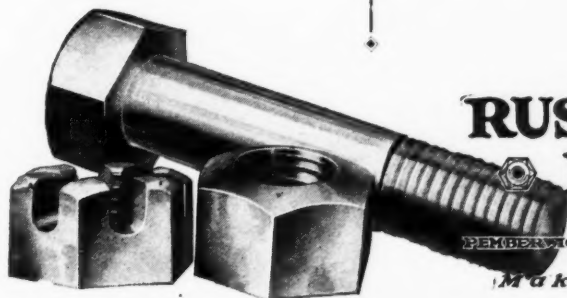
With Russell, Burdsall & Ward

THE knowledge that comes from experience is handed down from generation to generation in the Russell, Burdsall & Ward plants.

The skill of the beginner is constantly measured by the skill of the master.



A Significant Fact
The "more-than-thirty-years" honor roll at the Russell, Burdsall & Ward plants now contains 82 names

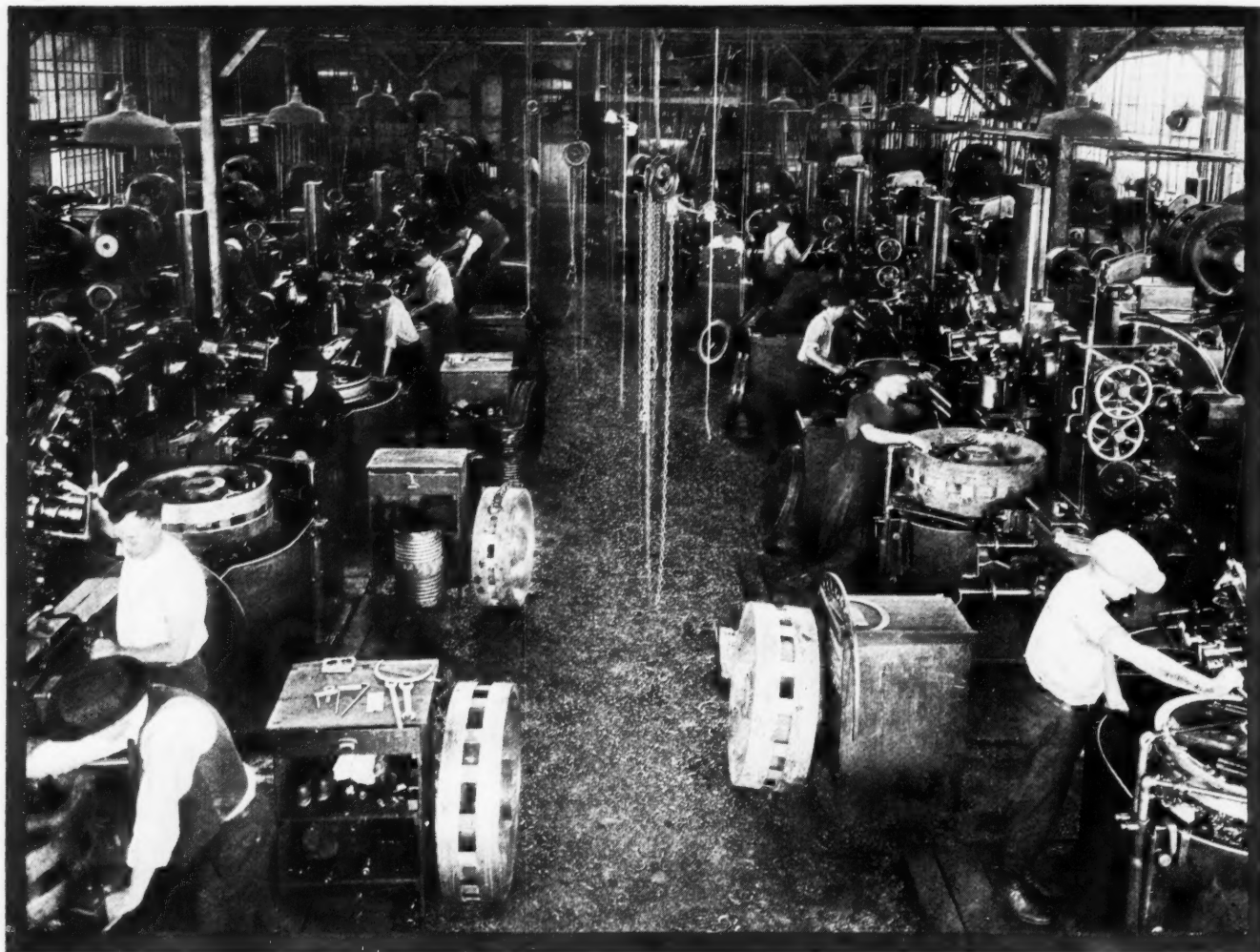


RUSSELL, BURDSALL & WARD
BOLT & NUT COMPANY

PORT CHESTER, N.Y.

PEMBERTON, CONN. • CHICAGO • SAN FRANCISCO • ROCK FALLS, ILL.

Makers of Bolts, Nuts and Rivets Since 1845



Getting Down to Facts on the Vertical Turret Lathe

THIS is the way they line up for the production of Manganese Steel Truck Wheels. There's no question about production—and the reason lies right in the Vertical Turret Lathe. A sturdy machine for heavy cutting and accurate finish—Two Heads cutting at once, and turret tooling.

Elimination of waste time and energy—Vertical Chucking, Centralized Control, Power Rapid Traverse, and

Quick Change of Speeds and Feeds to suit the cuts.

Continuous Flow Lubrication with sight feed and a Flood of Cutting Compound to the work. Here's a tool worth your investigation; it has "A Reputation Built on Performance." The Vertical Turret Lathe is built in 24", 36", 42", and 54" sizes.

Send for our book on "Cutting Time Between Cuts." It will give you several hints on how to Cut the Cutting Time, too.

BULLARD

THE BULLARD MACHINE TOOL COMPANY
Bridgeport, Conn.

Builders of The Multi-Au-Matic, The Vertical Turret Lathe, The Maxi-Mill and The Continuous Chucking and Turning Machine.

Makes the car easier to sell



The Universally Accepted
Standard of Car Locks

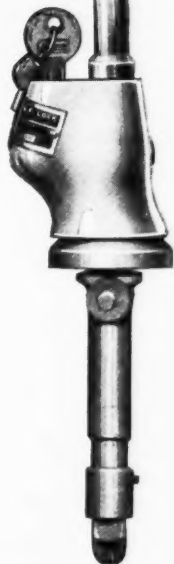
Standard Equipment on the Following Cars:

Auburn
Dorris
Duesenberg
Elcar
Kissel
Mercer
Moon
R. & V. Knight
Rickenbacker

Also Made for These Cars:

Nationally sold and in-
stalled by their dealers,
\$15.00

Auburn
Buick
Case
Chandler
Chevrolet
(including Superior
Models)
Cleveland
Dodge
Dort
Durant
Gardner
Hupmobile
Maxwell
Nash
Oakland
Olds
Packard Single Six
Roamer



Car buyers have come to expect the Johnson Transmission lock as standard equipment

To the car buyer the Johnson Transmission Lock is a sure safeguard against the theft of his car. But to you as a motor car manufacturer, it has come to mean a safeguard against *sales resistance*. Car buyers now expect it as standard equipment. Hundreds of thousands are now in use.

Now Standard Equipment on Many Cars

The list of cars on which the Johnson Transmission Lock is standard equipment, and the cars for which it is made, reads like a roll call of most of the representative better known cars of America. Wherever its dominant sales advantages have been weighed against cost it has been included as standard equipment.

It Locks the Gears

The Johnson Transmission Lock is a part of the gear shift lever—an exact duplicate of the one on the car. Can be adapted to practically all levers with few minor changes, at slight additional cost. It locks the car in neutral. The car must be unlocked before it can be run. Can't lock while the car is running. Nothing to wear loose or rattle.

Most Convenient to Lock and Unlock

Being up off the floor the Johnson Transmission Lock is most convenient to lock and unlock. Within easy reach of the driver, without tying himself up in a knot. Away from the floorboard. Away from any dirt, oil and grime. Approved by Underwriters' Laboratories, there is a flat reduction of 20% on theft insurance premiums.

A Demonstration-Conference at Your Plant

A practical demonstration and conference at your plant, covering every angle in connection with this Nationally Advertised lock will be made at your convenience and without obligation.

Address Dept. G.

Johnson Automobile Lock Co.

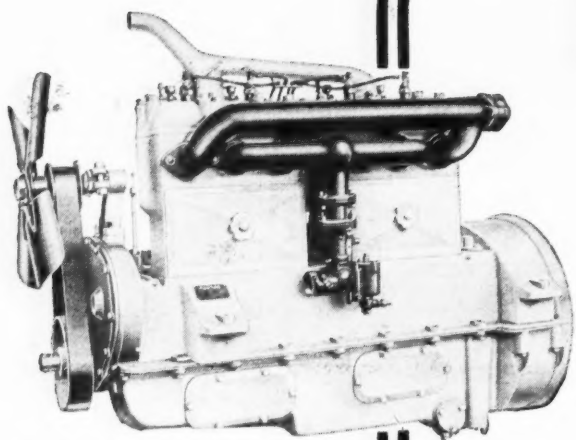
Makers of the famous Johnson Spare Tire Lock
St. Louis, U. S. A.

Johnson

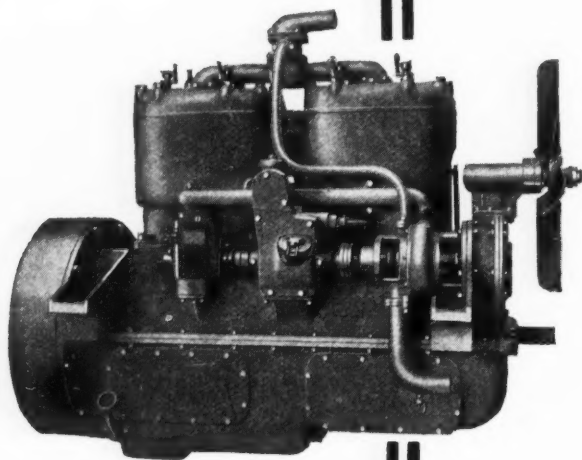
TRADE MARK REG. U. S. PAT. OFF.

TRANSMISSION LOCK

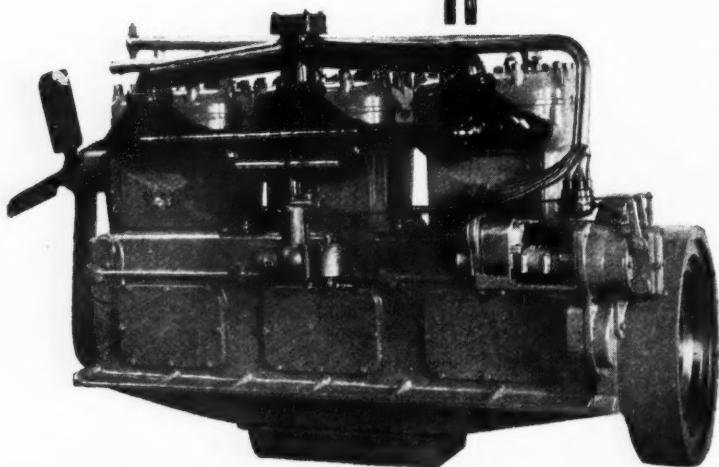
No Question About the POWER



Model K. U., 4-cylinder, 5" x 6½,"
800-1100 R. P. M., 25 to 45 H. P.,
gasoline or kerosene.



Model T. U., 4-cylinder, 5½" x 7,"
750-1000 R. P. M., 35 to 75 H. P.,
gasoline or kerosene.



Model R-6, 6-cylinder, 5½" x 7,"
800-1200 R. P. M., 60 to 120 H. P.,
gasoline or kerosene.

*when your
machines are
equipped with*

CLIMAX

"THE TRUSTWORTHY ENGINE"

Designed and built especially for heavy automotive and industrial work where 25 to 125 H. P. is required.

If you build or use trucks, tractors, industrial locomotives, cranes, hoists, power shovels, excavators, ditching machines, rock crushers, grinders, oil or water pumping outfits, electric generator drives, air compressor sets, or other heavy duty machines, you will be interested in the fact that Climax Engines have proven uniformly dependable for each of these power purposes, and that

"No regular user of Climax Engines has ever changed to any other make."

Write for Catalog

CLIMAX ENGINEERING COMPANY

6 W. 18th Ave.

CLINTON, IOWA



Hardwood Statistics

HARDWOOD MANUFACTURERS INSTITUTE announces the inauguration of its statistical program in cooperation with the U. S. Department of Commerce for the widest distribution of Hardwood Information. This endeavor consists of:

Past sales report (weekly) itemized, Stocks on hand at the source of supply (monthly) by species, grade, thickness and territory

The program provides that these statistics shall be available to Consumers of Hardwoods, to producers whether identified with HARDWOOD MANUFACTURERS INSTITUTE or not and to the public.

The cost of these reports to Consumers is \$94.85 for the first year ending June 30, 1924.

At all times there is the greatest need for current accurate figures respecting production and distribution. Such information is of vital and direct importance to commerce and industry. It benefits alike the producer, distributor and the consumer.

All business dealings necessarily involve an estimate of the future and if foresight is to be intelligent, it must be based upon a sound knowledge of present facts and conditions.

Further information upon request.

*HARDWOOD MANUFACTURERS INSTITUTE

1020 SOUTH WABASH AVENUE

CHICAGO

**An Association of Hardwood Producers, National in Scope, Dedicated to Reduce Waste Thru Cooperation with Consuming Industry*

UPSET

Namco-made screws

Just Screws— or is there a difference?

When you get down to an actual comparison of fit and finish in Upset Screws, you will find three important factors that vary as widely as there are makers of Upset Screws.

Check up Screws for thread uniformity, strength and finished appearance. These are practical points wherein we claim to offer you advantages. And if this is so why not have them?

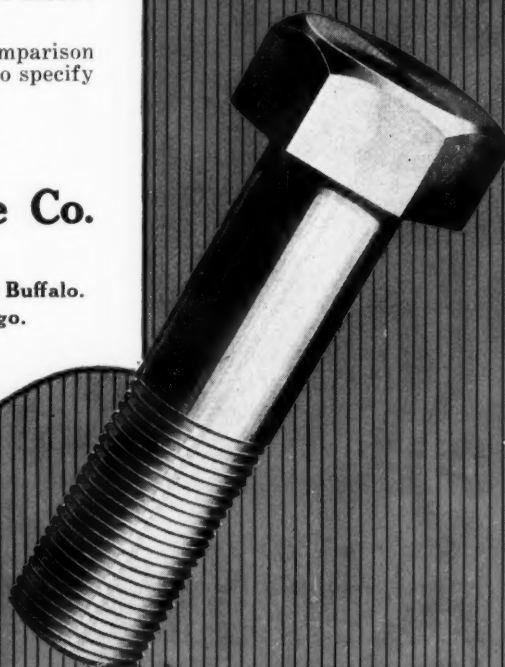
Since we raised the question of quality, we naturally invite your comparison of Namco made S. A. E. and U. S. Cap and Set Screws with any similar product.

We confidently believe that after comparison and test your judgment will lead you to specify Upset Screws that are Namco made.

There is a difference—specify Namco.

The National Acme Co.
Cleveland, O.

New York, Boston, Chicago, Detroit, Buffalo.
Warehouses—New York, Chicago.

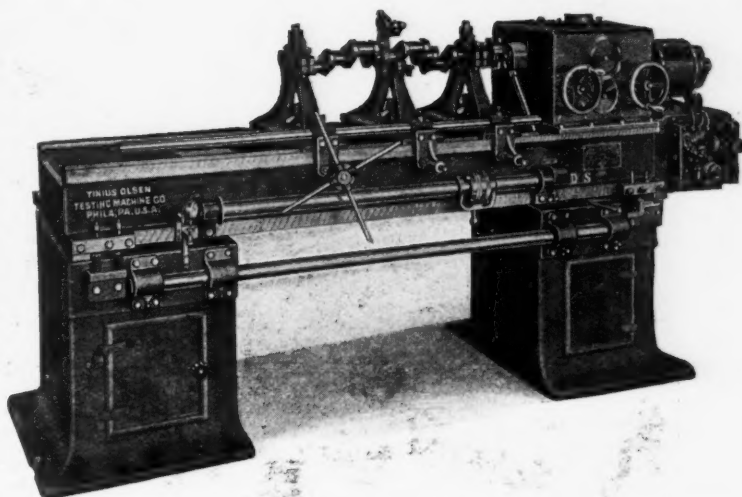


Eliminate Vibration — Secure Perfect Balance

THE Olsen-Carwen Static-Dynamic Balancing Machine will accurately balance your parts on a 100% Production basis at a minimum cost.

The Olsen-Carwen eliminates all guess work, cut and try methods and engineering, as it *indicates* on dials the amount of unbalance and location of same.

Send for technical pamphlet.



How Do You Correct Your Connecting Rods?

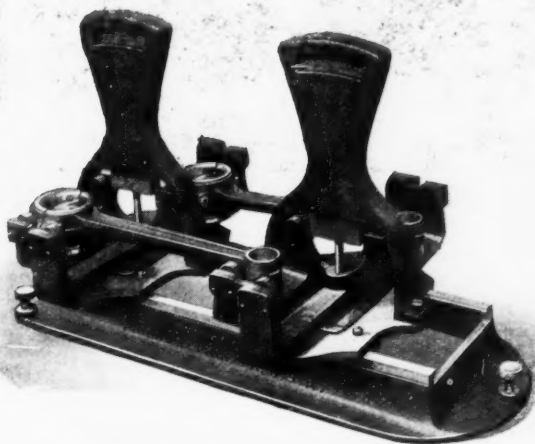


PLATE NO. 2039—Pat. Applied For
THE STANDARD FOR QUALITY THE WORLD OVER

ALL connecting rods should be corrected with reference to their total weight and location of center of gravity, i. e., each end must weigh the same and the sum total of the two ends the same.

The Olsen-Lundgren Automatic Weighing Connecting Rod Scale will at a glance and in a single operation, weigh such parts accurately and so that each and every connecting rod will weigh the same.

Standardize your connecting rods and reduce your costs by the Olsen-Lundgren method.

Olsen - Carwen Static-Dynamic Balancing Machines

Eliminate Vibration—Secure Perfect Balance with Speed and Economy

The Olsen-Carwen Machine is made in many sizes and types to balance any rotating parts from the smallest to the largest rotor made. Now used by all the leading up-to-date automobile and motor manufacturers throughout the country.

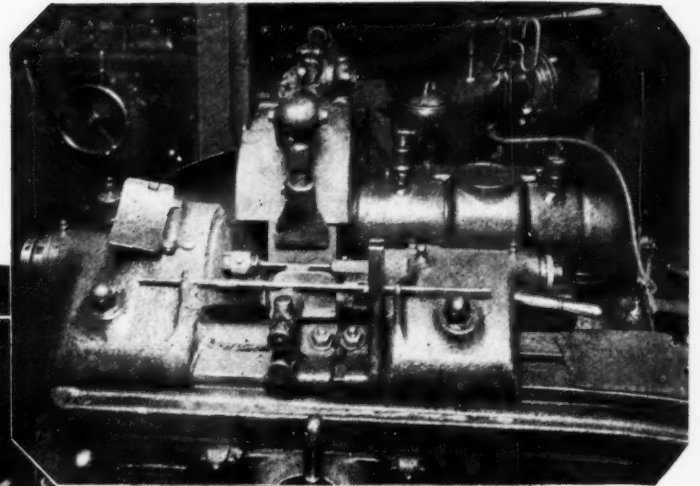
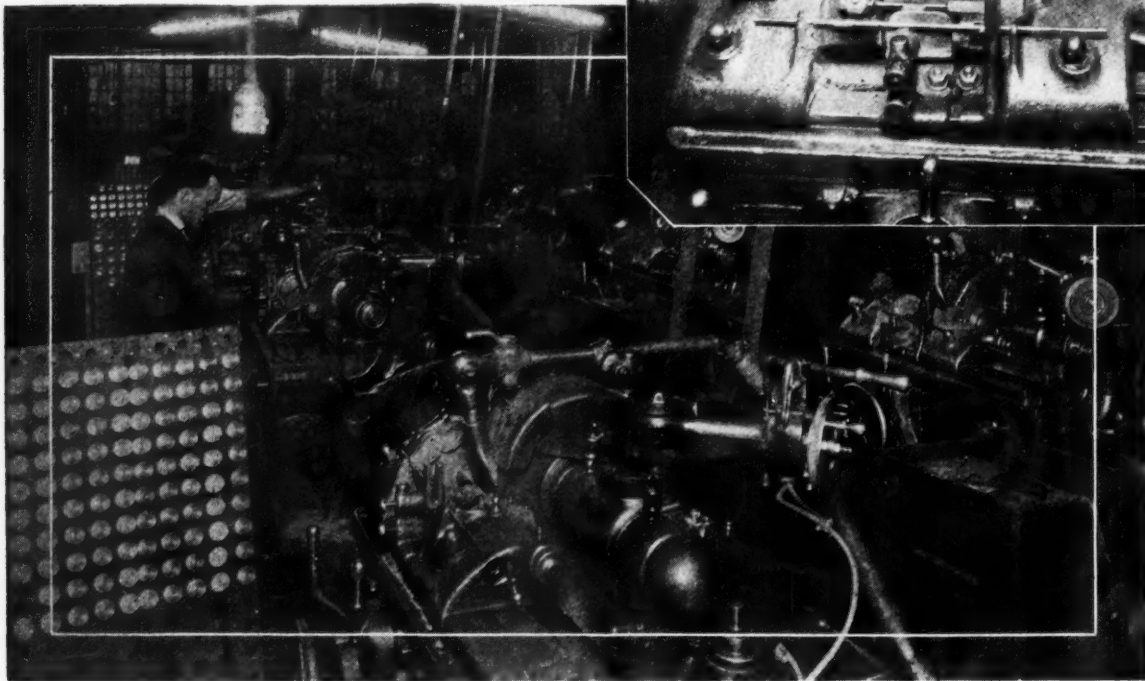
SOLE MANUFACTURERS

TINIUS OLSEN TESTING MACHINE COMPANY

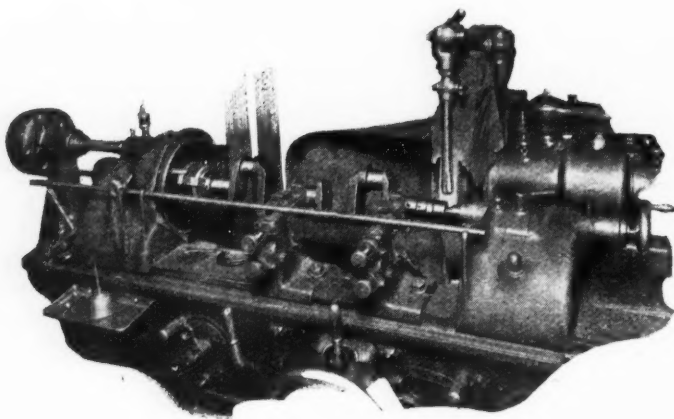
500 North Twelfth Street, Philadelphia, Pa., U.S.A.

Foreign Representatives—Messrs. R. S. Stokvis & Fils, Paris, France; Brussels, Belgium; Rotterdam and Amsterdam, Holland; Edw. G. Herbert, Ltd., Manchester, England, Andrews & George Company, Tokyo, Japan.

Valve stems brought to size in 23 seconds. A high finish. No taper. On the average, but two passes of the broad-faced wheel are required. (Note the special live center for driving the valve. Also the steady-rest, to hold the stem up to the pressure of the feed used.)

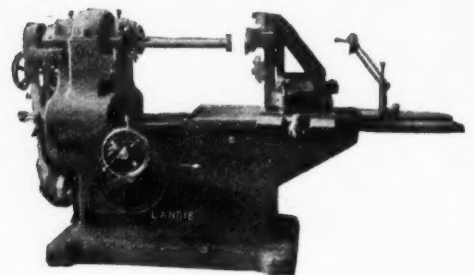


How a high production shop in Detroit grinds the periphery of valve-heads on a battery of Landis Plain Grinding Machines. A wheel $1\frac{1}{2}$ " wide is used and no traverse is required. Production on this operation is limited only by the operator's ability to get the valve in and out of the grinder.



Landis 12" x 36" Plain Grinding Machines are very extensively used on the line-bearing of crankshafts. Batteries of these machines keep production at peak in engine-building shops everywhere.

The LANDIS Cylinder Grinder—a rugged, extremely simplified machine. Built up to the LANDIS standard of excellence, yet sold at a very attractive price.



You Can PAY More for Grinding Equipment—

*But no one nowadays expects to buy
more day-in-and-day-out productive ability.*

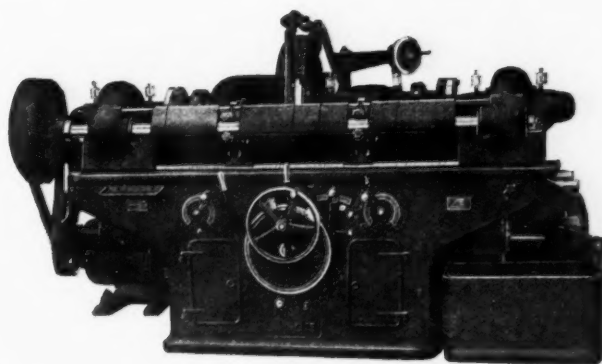
IN no other field of manufacture are so many grinding machines used as in the automotive. In no other field are buyers more on the alert for anything that will raise production and lower costs.

There are hundreds of LANDIS installations in the automotive manufacturing field. It seems as though the industry has seen fit to standardize on them—not for any single attribute, but for their general suitability where ACCURACY and high PRODUCTION must go hand in hand.

Whether the work is valves, shackle bolts, pistons, cylinder blocs or crankshafts, there is a LANDIS which has been designed for that very purpose.

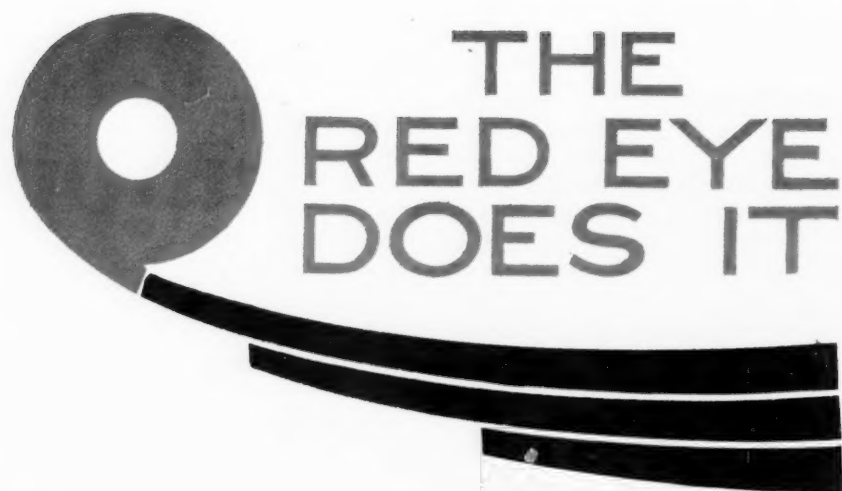
We are the largest builders of grinding machines, and because of the volume we enjoy, can afford to give GREATER VALUE per dollar in whatever type machine is selected.

We are always glad to receive blueprints or actual samples of work so that our engineering department can furnish time estimates as a basis for comparison.



LANDIS TOOL COMPANY, Waynesboro, Penna.
New York Office, 51 Chambers Street

LANDIS



Truck Manufacturers

—THIS IS WRITTEN TO YOU

It puts you in touch with the scientific solution of one of your most vexing problems—spring breakage.

The RED EYE is the perfection of a new spring making method—a process that banishes chance of spring crystallization, and ultimate destruction.

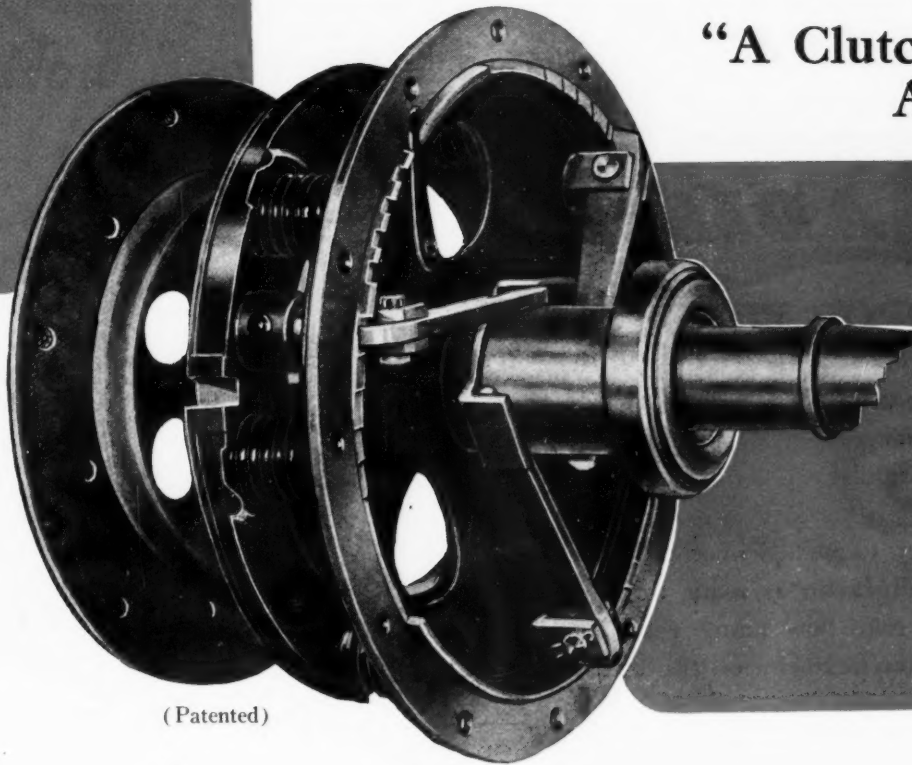
Springs made under this method give smooth riding qualities and are protected by a wear-resisting feature that is peculiar to the RED EYE process.

The SAVING SPRING COMPANY

ASHLAND, MASS.

"M & E" AUTOMOTIVE DEVICES

"A Clutch with Velvet Action"



(Patented)

Flexible "M & E" Clutch

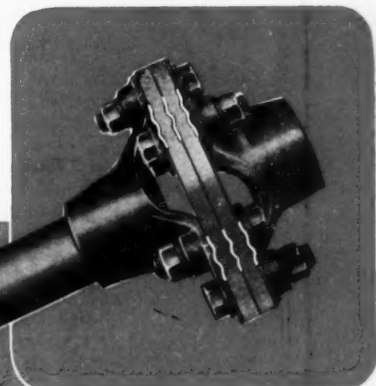
FIFTY-THREE pleasure car and truck manufacturers are testing the Flexible clutch. Six reputable concerns have completed their tests and all have adopted it as standard equipment.

"The Reason Why"

Its simple construction permits a light

pedal pressure, smooth engagement, positive release, and easy noiseless gear shift. It is the only clutch with a fool-proof, visible adjustment.

It is low in cost, and exactly replaces clutches made for standard 8", 10" and 12" flywheels. Our production capacity is 4,000 clutches per day.

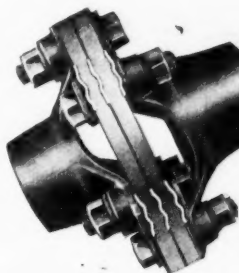


"A Silent Cushion Drive"

Our Engineering
Department is at
your Service.

Griptite "M & E" Universal Joints (Pat. Pend.)

Standard Equipment on 30 models of trucks, speed wagons, pleasure cars and gasoline rail-cars. Absorbs driving-shocks. Protects axles and transmissions. Drive taken through steel washers conforming to molded ridge on discs. No disc distortion. No vibration.



MERCHANT & EVANS COMPANY
PHILADELPHIA

LADISH QUALITY **DROP FORGINGS**

To determine how well and to what extent LADISH Drop Forgings are serving the automotive industry it is only necessary to glance over the list of manufacturers using them and to note how many years each name has been on the list.

Short of an actual trial of the forgings, this is perhaps the best method of "sizing up" a drop forging organization and its products.

We will welcome a complete investigation.

LADISH DROP FORGE CO.

Cudahy (Suburb of Milwaukee)

Wisconsin

"The Axle Forgers of the Industry"



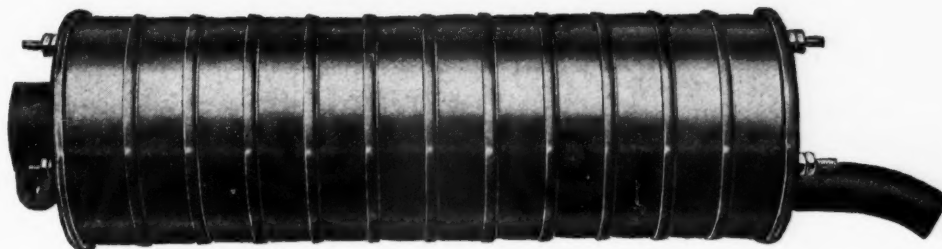
"To Mark Progress"



Now Ready

POWELL MUFFLER

Blow-Out Proof



I am the exhaust from any gasoline engine. I wish to announce that the Powell Mufflers are now made with plate steel heads in place of malleable iron.

Send for a sample if you want a good muffler; they will not blow out, are light in weight, and can be taken apart for cleaning.

Take it from me, they are the best muffler made.

Yours truly,

THE EXHAUST GAS.

List of Companies Using Powell Mufflers

Automobiles

Barley Motor Car Co.
Checker Cab Mfg. Co.
Crawford Automobile Co.
Cortland Cart & Carriage Co.
Dorris Motor Car Co.
Daniels Motor Car Co.
Fox Motor Company
H. H. Franklin Mfg. Co.
Kelsey Motor Co.
McFarlan Motor Corp.
Nordyke & Marmon Co.
H. C. Stutz Motor Car Co.
F. B. Stears Co.
Winton Company
Yellow Cab Mfg. Co.
Fifth Ave. Coach Co.

Lighting Plants

Caron Bros.
Chicago Pneumatic Tool Co.
Solar Farm Light Corp.

Trucks

Acme Motor Truck Co.
Acme Road Roller Co.
American Motor Truck Co.
The Autocar Co.
Abbot-Downing Truck & Body Co.
Atterbury Motor Car Co.
Brockway Motor Truck Co.
Beaver Truck Corp., Ltd.
Buffalo Truck & Tractor Co.
Clydesdale Motor Truck Co.
Diamond T. Motor Car Co.
Rowe Motor Mfg. Co.
Day Elder Motors Corp.
Fageol Motors Corp.
Four Wheel Drive Co.
Giant Truck Co.
Garford Motor Truck Co.
Gary Motor Truck Co.
Harrisburg Mfg. & Boiler Co.
Kleiber Motor Truck Co.
King-Zeitler Motor Truck Co.
Krebs Motor Truck Co.
Kelly-Springfield Motor Car Co.

Larrabee-Deyo Motor Truck Co.
La France Fire Engine Co.
Master Truck Corp.
Maccar Truck Co.
Noble Motor Truck Co.
Northway Motors Co.
New England Motor Truck Co.
Nelson-LeMoon Motor Car Co.
Parker Motor Truck Co.
Packard Motor Car Co.
Rainier Motor Corp.
Riddle Mfg. Co.
Sanford Motor Car Co.
Sullivan Machinery Co.
Stewart Motor Corp.
Service Motor Truck Co.
Selden Truck Corp.
Vim Motor Car Co.
Vreeland Motor Car Co.
White Motor Co.
Walker-Johnson Motor Corp.
Wachusett Motor Co.
Walter Motor Car Co.
O'Connell Motor Truck Co.

POWELL MUFFLER COMPANY

UTICA, NEW YORK

Western Felts

"Cut by the Maker"



Keep Toes
Warm in January
Cool in June



Instead of this ~ this



Fitting snugly around the pedal arms and the steering column, this toe-board gasket contributes immensely to the comfort of driving. Need we suggest that a more comfortable car is a more salable one?

The flow of hot air around the feet in summer is stopped. Likewise the draft that chills toes in winter. Pedals cannot squeak against toe-boards. Dust and grit are excluded. So are odors from hot oil, and burnt gas.

Friction is constant on a toe-board gasket. So is pressure. Other deteriorating agents work steadily—oil, gas, heat, abrasive dust. But the tough mat of long fibres in Western Felt is proof against them. When the car is junked, the felt will still be doing its work.

Suppose you send a blueprint of your toe-board layout for an estimate?

WESTERN

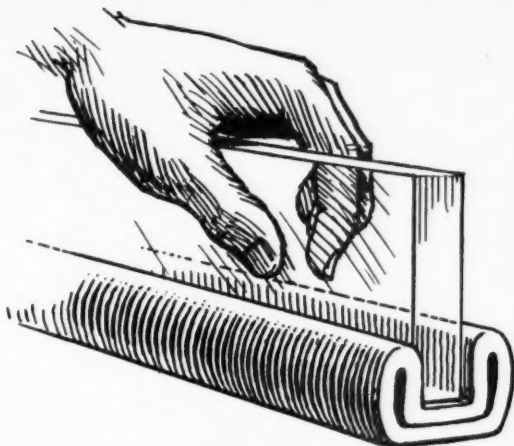
Factory & General Offices

BRANCHES

42-44 East 20th St., New York

10 High Street, Boston

Union Trust Bldg., Detroit.



In this, the largest complete felt factory in the industry, we are able to turn out any amount of cut felts from a wide variety of weights, thicknesses and hardnesses of sheet stock in our warehouse. We have also a fully equipped machine shop for turning out dies of any shape or size on short notice.

Raw-Edged Glass Does Not Affect WESTERN *Folded* CHANNEL



A piece of freshly broken plate glass was energetically sawed back and forth in a length of Western *Folded* Channel. After more than fifty strokes the tough felt was very slightly cut, and the threads holding the fold untouched.

Knowing how hard it is to get glass ground perfectly true and smooth you will appreciate this power of Western Felt to resist abrasion.

Western Felt Channel is now made in one piece so folded that the stitches come nowhere near the edges of the glass. This removes the slightest

possibility of folded channel ever breaking out of its groove or causing the glass to stick.

Western Felt Channel is made of hard, tough, long fibre felt, which retains its elasticity throughout the life of the car. It does not harden and cause pounding or rattling.

By means of the air chamber at each side it accommodates itself to wide variations in glass thickness. Since all the wear comes on the surface instead of on the cut ends of the fibres, Western *Folded* Channel does not fray or spread lint. It is cut to size and shipped ready for use. Dictate a note asking for quotations.

FELT WORKS

4031-4117 Ogden Avenue, Chicago

BRANCHES

Postal Telegraph Bldg., San Francisco

Finance Bldg., Cleveland

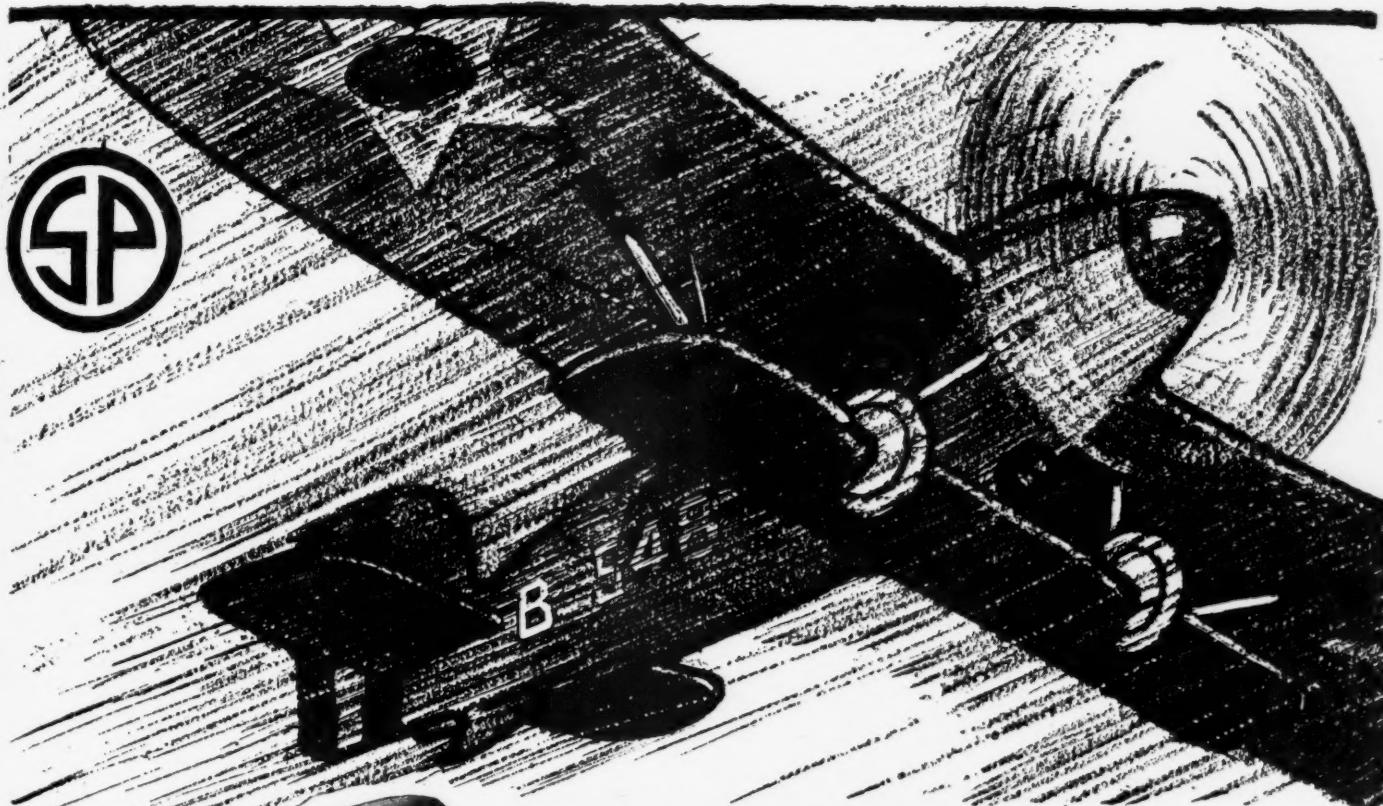
Odd Fellows Bldg., St. Louis

A thing Worthwhile
is Worth Doing
Correctly

"Van Dorn"
GEARING
Quality Gears
are Made
Correctly

THE VAN DORN & DUTTON COMPANY
Gear Craftsmen
CLEVELAND, OHIO
~ U.S.A. ~





For greater engine stamina

United States military fliers
now hold world's records for
duration, speed, distance and
altitude, making America
"First in the Air". Congress'
aviation appropriation for
the fiscal year 1923-24 totals
\$29,311,450.00.

Non-burning
Non-warping
Non-scaling
Non-air-hardening
Weigh least
Wear longest
Moderately priced

IN a recent full-throttle block test under government supervision a Wright E-4 aeronautical engine equipped with Thompson Silcrome Valves was pulling more horse-power after 310 hours than at the beginning.

This remarkable demonstration of engine stamina gives evidence that the seating and sealing qualities of the Thompson Silcrome Valve actually improve with service—a characteristic possible only in a valve that does not burn or warp, and that is tremendously wear-resistant.

For greatest engine ruggedness and efficiency, specify Thompson Silcrome Valves. Many manufacturers now doing so began with tests that had the deliberate object of running sample sets of Thompson Silcrome to destruction. We invite interested car and engine builders to conduct similar tests.

—built by a "trail-
breaker of industry"

THOMPSON SILCROME VALVES

THE STEEL PRODUCTS COMPANY

MAIN PLANT
CLEVELAND

Also manufacturers of king bolts, shackle bolts, tie rod bolts,
drag links, starting cranks, and brake rod assemblies

MICHIGAN PLANT
DETROIT

400° Baked Finish Be Renewed~Saves

THE Oxvar Method has been released for use to all manufacturers after five years of experimental work and three years of big volume production on the standard models of a leading car.

The facts of the Oxvar Method sound revolutionary, and are, but they have already been demonstrated to several large manufacturers.

By the Oxvar Method wood frame bodies can be baked to 400° without charring, loss of resiliency and moisture, or development of squeak.

—only three to five coats of enamel are required and only one visit to the rubbing deck.

—only 4½ to 7½ hours are required for the complete process of finishing.

—the resulting finish is almost glass hard, high in lustre, extraordinarily tough and elastic.

—the finish is as permanent as the car.

Bodies which have traveled over 50,000 miles over every variety of roads, in all kinds of weather, are as lustrous as when they left the factory—show no signs of dimming, checking or lifting.

Consider what this means to the manufacturer in these days of speeded-up production.

He can finish a body and obtain a result far superior even to the highest grade paint job

in one-tenth the time it takes him to turn out an inferior forced dry air or semi-bake job. He can do this at a labor cost of approximately \$1.85 per body as compared with \$6.85 labor cost for the lowest-priced body on the market.

Oven equipment is lessened and the space for drying cut down by nine-tenths.

The saving in investment and on interest on capital invested is enormous.

Oxvar Finishing keeps pace with production.

Resale of used cars is facilitated—no re-finish required.

Where refinishing of color jobs is desired they can be cut back to the Oxvar undercoats instead of to the metal.

Our service engineers are prepared to submit complete data and plans to factory executives.

Descriptive booklet covering the principal features and typical cost analysis will gladly be mailed on request to any known member of the automotive industry.

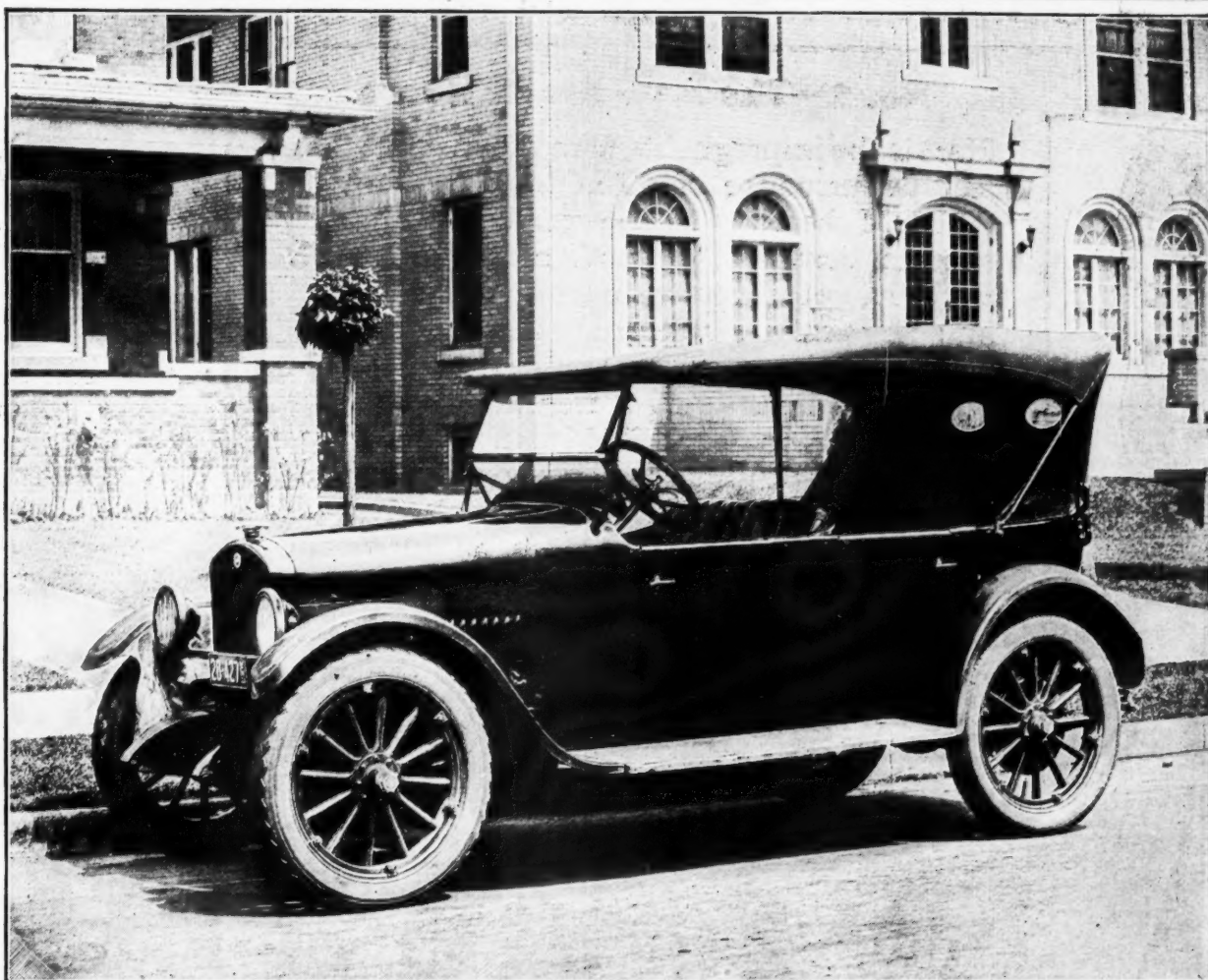
OXVAR

OXFORD VARNISH CORPORATION

Main Office:
EMPIRE BUILDING, DETROIT

Plant:
TOLEDO, OHIO

That Need Never $\frac{2}{3}$ Cost, $\frac{1}{10}$ Time



EVEN AFTER THREE YEARS OF ABNORMAL USE

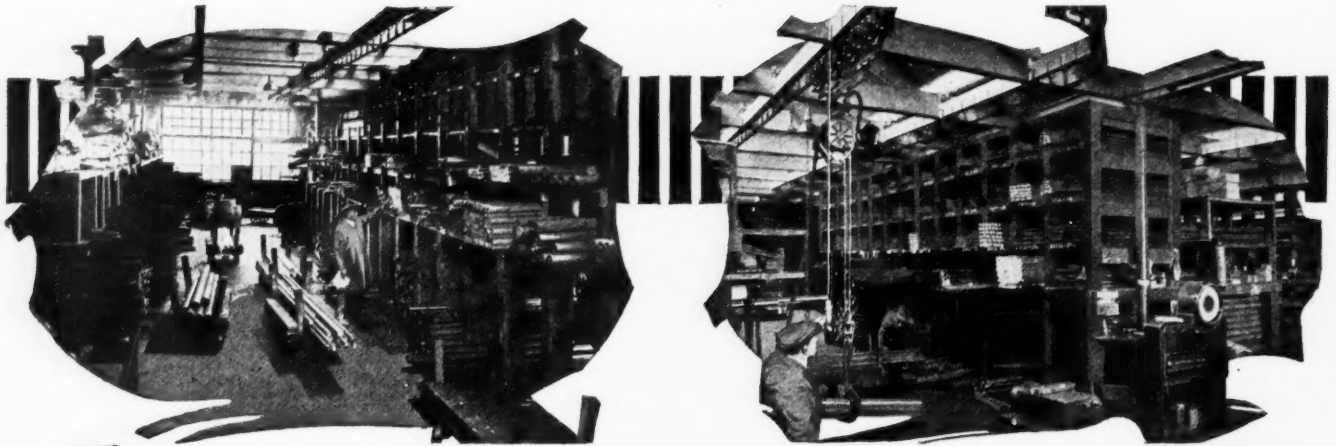
THIS unretouched photograph shows a car that has been in use since 1920 and has run over 45,000 miles for various owners under all weather and road conditions. It has never been revarnished or refinished in any way.

Observe the unmarred surface of the Oxvar-finished body. Note that the fenders were not done by the same process.

The complete job of application, pumice rubbing and hi-baking to 400° took only 7 hours. The labor cost was \$1.85. The cost of material, \$3.

This is not an outstanding example specially selected for illustration, but a fair sample of hundreds of other Oxvar-finished bodies after three years of use.

Oxvar is as permanent as the car.



Factors in **STROM** BALL BEARINGS Supremacy

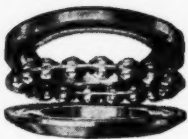
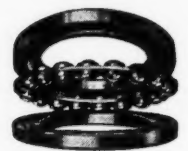
No. 2—The Raw Stock Room

Here is the impregnable foundation of the perfect performance of STROM ball bearings. STROM bearing steel—made to our own specifications, by America's most expert steel workers, yet subjected to searching chemical and physical tests before use—has that unvarying and exact texture which alone could withstand the untiring watchfulness and machine precision of STROM ball bearing production. Such raw material—plus constructive testing and analyzing continued from bar-stock to shipping-box—is an important factor in determining STROM supremacy.

STROM guaranteed ball bearings, on *new* or *replacement* work, reduce friction to the vanishing point—

"Wherever a Shaft Turns"

(1976)



*An Organization
Built for Precision*

*Scientific in Principle
and Practice*

STROM

BALL BEARINGS

U. S. Ball Bearing Mfg. Co.
(Conrad Patent Licensee)

453 Palmer St., Chicago, Ill.

Precision in manufacture assures positive grip

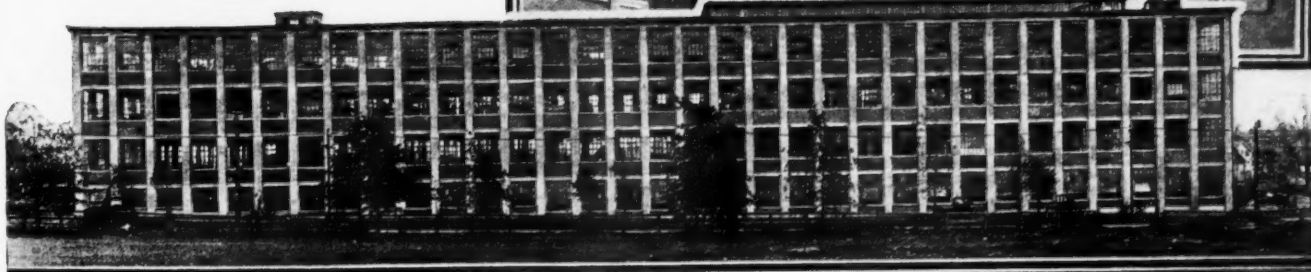
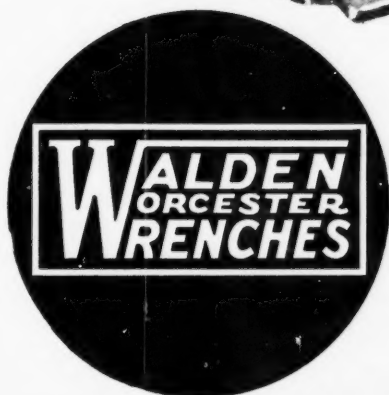
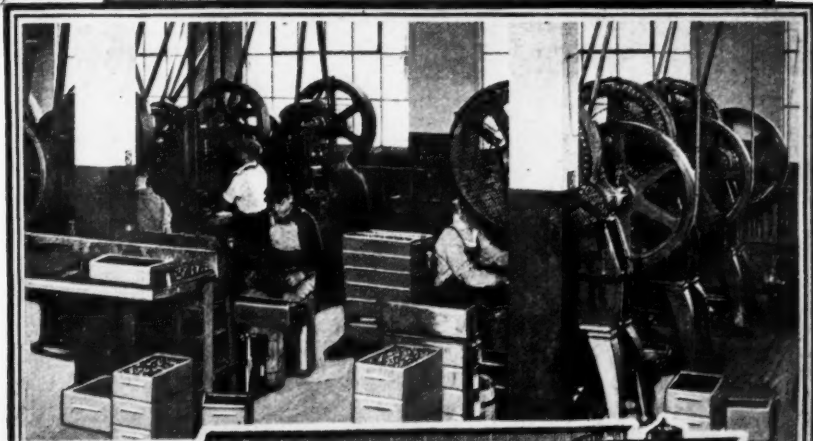
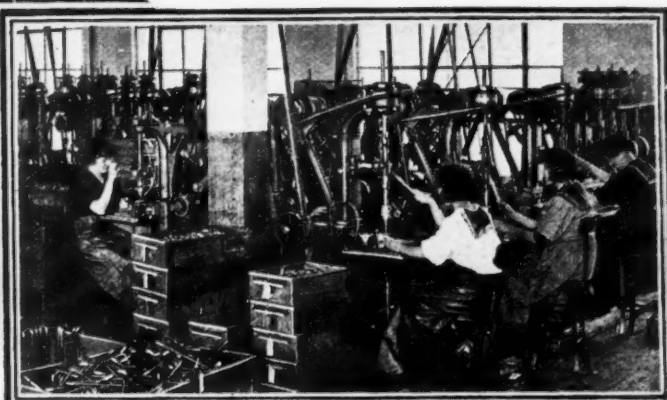
Individuality of shapes permits easy and instant selection—saving time in assembly departments and service stations.

Time saving tools made the flat rate profitable.

WALDEN-WORCESTER

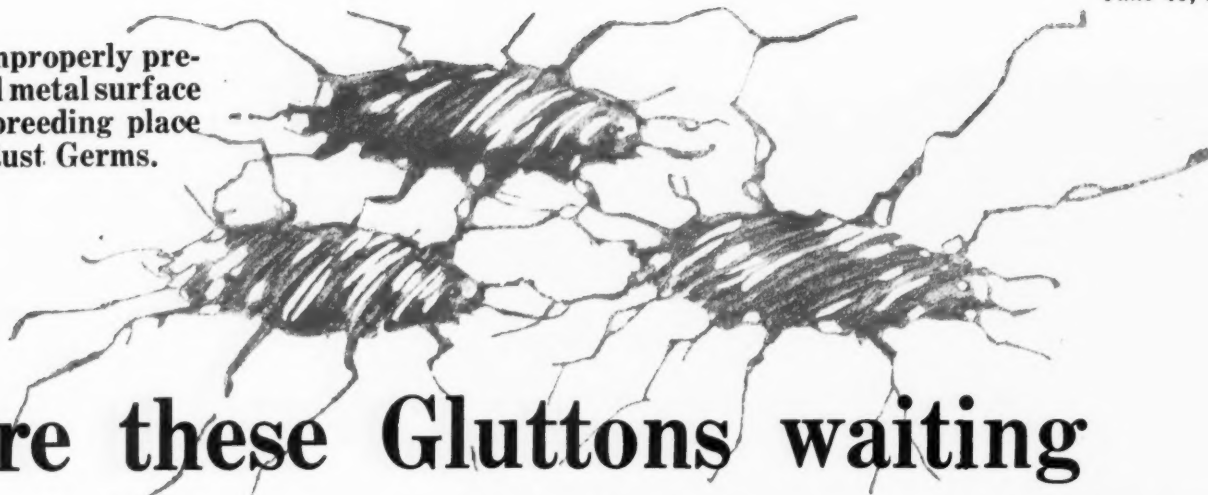
Incorporated

GENERAL OFFICES AND FACTORY
WORCESTER, MASS.



WALDEN-WORCESTER—LARGEST EXCLUSIVE BUILDERS OF SOCKET WRENCHES IN THE WORLD

An improperly prepared metal surface is a breeding place for Rust Germs.



Are these Gluttons waiting to attack your product?

A.C.P. PRODUCTS AND PROCESSES are being used by 75% of all car manufacturers. Their use insures chemically and mechanically clean surfaces on which rust cannot develop.

DEOXIDINE

RUST REMOVER AND ACID NEUTRALIZER. Prevents work rusting under the paint. Write for Bulletin No. 10.

FLOSOL

SELF-CLEANING SOLDERING ACID. Cleans and fluxes in one operation. Write for Bulletin No. 11.

DEOXYLYTE

ACID NEUTRALIZER. Counteracts the rusting action of soldering acids. Write for Bulletin No. 11.

PEROLINE

ACID NEUTRALIZING, OIL-COATING. Neutralizes rust stimulators on the surface and prevents rust while the work is in storage or transit. Write for Bulletin No. 11.

KEMICK

HEAT RESISTING PAINT. A flat black chemical paint for exhaust manifolds, pipes and mufflers. Prevents rust and won't burn off nor turn brown even when heated to redness. Write for Bulletin No. 12.

RODINE

PICKLE CONTROL. Added to the concentrated pickling acid saves from 30 to 50 per cent of the acid and prevents pitting, over-pickling and fuming.

LITHOFORM

GALVANIZED IRON PRIMER. Chemically ages galvanized iron and destroys its paint shedding property. Write for Bulletin No. 9.

RIDOLINE

ALKALINE CLEANER. For removing oils and grease.

Samples sent on request.

THE careless or improper preparation of metal surfaces, before paint is applied, invites rust and rust is an insidious glutton bent on destruction.

Though microscopic in size, like the germ of tuberculosis, the Rust Germ is a powerful and persistent blight. Once it is allowed to gain a foot-hold it eats away without pause—weakening the metal and undermining the paint job.

The excellence of your product lies largely in the beauty and durability of its finish.

You select the best paints whose colors harmonize and whose surfaces are susceptible of exquisite finishes

—but if you have not given the same attention to the metal surfaces beneath the paint your efforts are wasted.

No paint job can endure that is carelessly applied over rust germs. Sooner or later the surface checks and peels and then comes owner dissatisfaction.

In the protection of your product against the ravages of rust we can help you.

Without charge we will gladly advise and cooperate in the improvement of your cleaning methods.

Taking advantage of this service means placing your painting department on a thoroughly scientific basis. It means paint jobs that will remain permanently beautiful and truly protective.

It means a substantial saving in production costs.

Write for complete details today.



American Chemical Paint Co.
1123 South 11th Street Philadelphia, Penn.
Protect the Paint that Protects your Product



Special Announcement

THIS announcement is occasioned by the radical changes made by Underwriters' Laboratories for approving automobile bumpers for insurance risks.

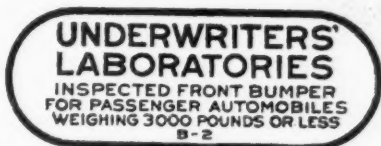
Effective July 1, 1923, all approved bumpers must carry the labels of the Underwriters' Laboratories.

Defender Bumpers are fully approved; in fact, Defender is one of the few bumpers approved under the new regulations.

Defender Bumpers

mean reduced insurance premiums.

Fac-similes of our labels are reproduced herewith— $\frac{4}{5}$ actual size.



NEW YORK WIRE AND SPRING CO., BUMPER DIVISION, HOBOKEN, N. J.

SHULER FRONT AXLES

for
MOTOR BUSES
MOTOR TRUCKS
TRAILERS &
TRACTORS



Concentration on one product by experienced engineers and efficient mechanics—and that's what we have in the Shuler organization—can result in only one thing—a *distinctly superior front axle*. This major unit is too important for any manufacturer to decide upon anything but the best that the market offers. Correspondence is invited from progressive manufacturers who are disposed to give the front axle the careful consideration that its importance demands. Our engineers are at your service.

Complete Information on Request

SHULER AXLE COMPANY, Incorporated

3001 Jones Street

Louisville, Kentucky, U. S. A.

Steel Tubing to lower your manufacturing costs

Many Manufacturers lower their production costs by using Rome Steel Tubing, which we are supplying to them practically ready for assembly—tubing on which very little, often no further manufacturing operations are required.

Our long experience in the manufacture of steel tubing, and the knowledge of its application in numerous industries should prove helpful to those using this product.

We can furnish welded, brazed, butted and lock joint tubing made of cold rolled or hot rolled steel. Made round, oval, square, rectangular and in special shapes — bent, formed and drilled for special purposes. Plain or covered with brass, bronze, or aluminum.

As others have found a big economy in Rome Tubing we feel you will. Send for a copy of our Tubing book.



Main Office and Works
ROME, N. Y.

ROME

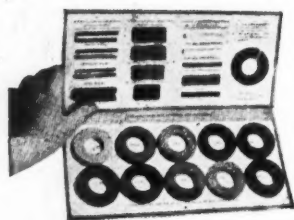
MANUFACTURING CO.

342 Madison Ave., New York. 1431 Lytton Bldg., Chicago. 610-614 Wells-Fargo Bldg., San Francisco.
60 India St., Boston. Woodbridge & McDougal Ave., Detroit



2115-V

Have You Complete Specification Data on **FELTS** ?



This folder shows various grades, shapes and samples, tabulated for ready reference. It will form a valuable addition to your felt data. This folder will be sent to interested executives on request.



Once established, the specifications of American Felt parts always remain the same. All the data and information is entered on specification tags and filed for future reference in our files. Tags for this purpose will be sent you if you will request them, telling us how many you can use.

THE subject of felt specifications for prevention of dust, retention of lubricants and elimination of squeaks and rattles is coming in for more consideration as the importance of this question is more fully realized. It is no longer a matter of merely using felt. It is now of recognized importance that the proper grade of felt be specified according to the results to be accomplished.

To simplify this matter of correct felt specification the American Felt Company has developed a service of distinct value to the automotive industry. The sample folder and specification sheet shown at the left are examples of part of this service. In addition, a staff of competent felt experts is maintained. It is the duty of these men to co-operate with engineers and other executives in the specification of proper grades of felt to be used in automotive vehicles. The services of these men may be had without obligation on your part.

We shall be glad to give you the benefit of our long experience and extensive service. A request to our nearest office will receive prompt attention.

American Felt Company

TRADE MARK



CHICAGO
325 S. Market St.
DETROIT
1915 Fort St. West
CINCINNATI
1 Greenwood Bldg.

NEW YORK
114 E. 13th Street
ST. LOUIS
1627 Locust Street
DENVER
134 E. 14th Street

BOSTON
211 Congress St.
PHILADELPHIA
37 Drexel Bldg.
SAN FRANCISCO
833 Market St.

HEXCEL

RADIATORS FOR PASSENGER, COMMERCIAL CARS AND TRACTORS

AMONG the many engineering advancements exclusive to this radiator is its defiance of vibration. By yielding to strain it avoids crystallization, and so adds materially to its service life.

Not a Cellular, Not a Tubular—but BOTH!

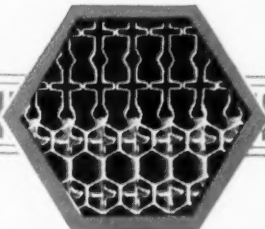
HEXCEL is the only radiator combining the heat-dissipating efficiency of cellular design with the free circulation of tubular construction. You can see the full length of each HEXCEL water channel—impossible in other cellular cores. Each drop of water makes direct metal-to-air contact—impossible in other tubular cores.

Principles embodied in this radiator should interest engineers seeking highest efficiency from the minimum of metal.

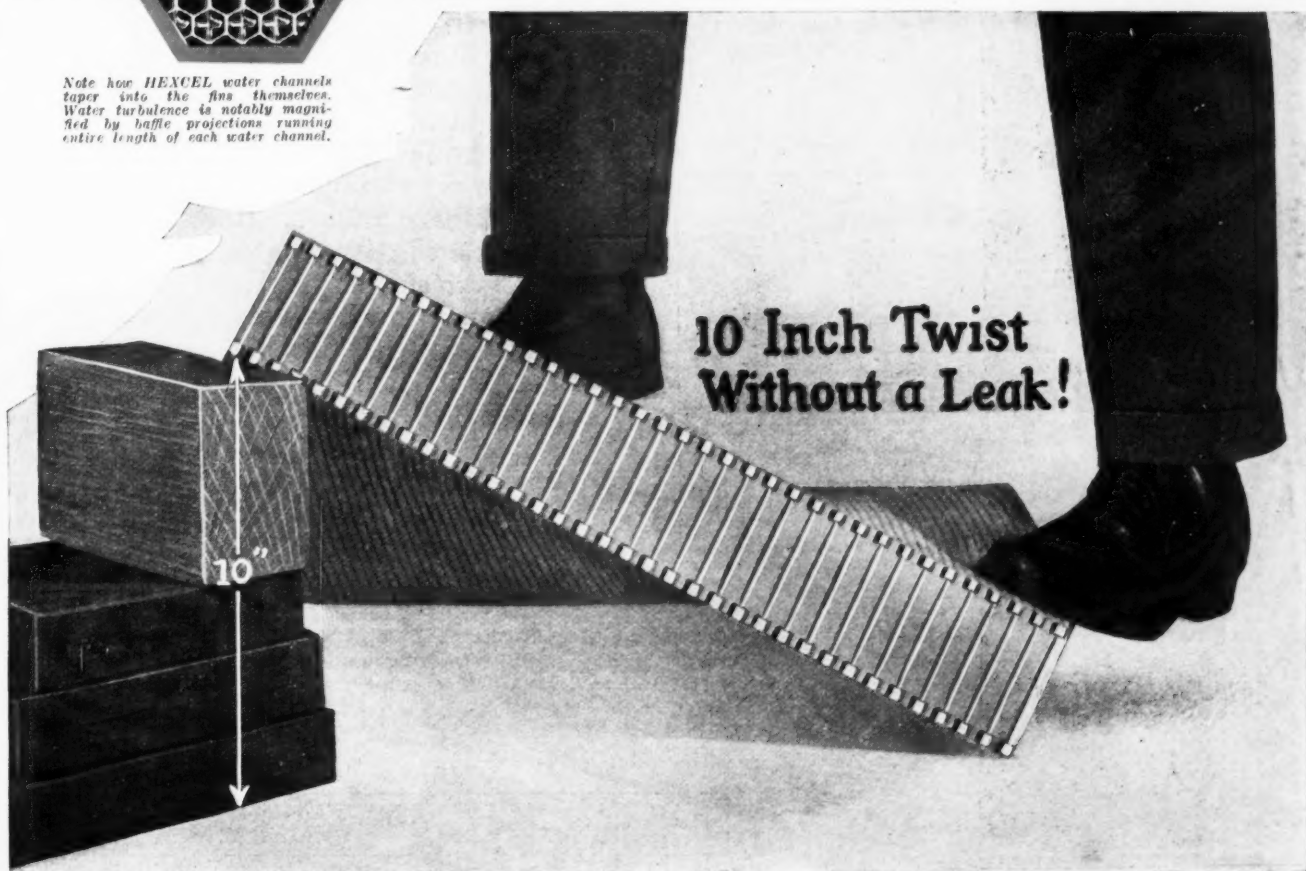
At your request, our Engineering Department will gladly submit further evidence and more detailed information with the view of exchanging specifications.

OPITZ MFG. CO., Dept. G-5, Milwaukee, Wis.

Designers and Builders of Engine Cooling Systems

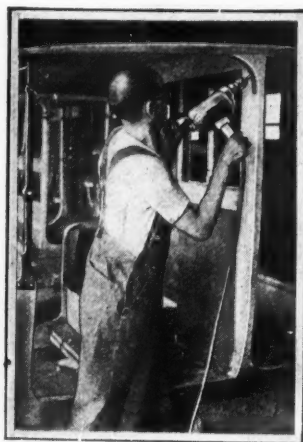


Note how HEXCEL water channels taper into the fins themselves. Water turbulence is notably magnified by baffle projections running entire length of each water channel.





UNITED STATES Portable Electric DRILLS



THE life of a portable electric drill is largely one long round of abuse and neglect. It takes a drill of the "U. S." calibre to stay on the job year after year throughout an endless career of hard knocks. U. S. Portable Electric Drills have the essential qualities of strength, ruggedness, lightness, power, and balance to fit them for the job. Cool running. Ball bearings. Universal motor. Write for catalog 20-A.

**The UNITED STATES
ELECTRICAL TOOL CO.
CINCINNATI, OHIO,**

District Sales Offices and Service Stations

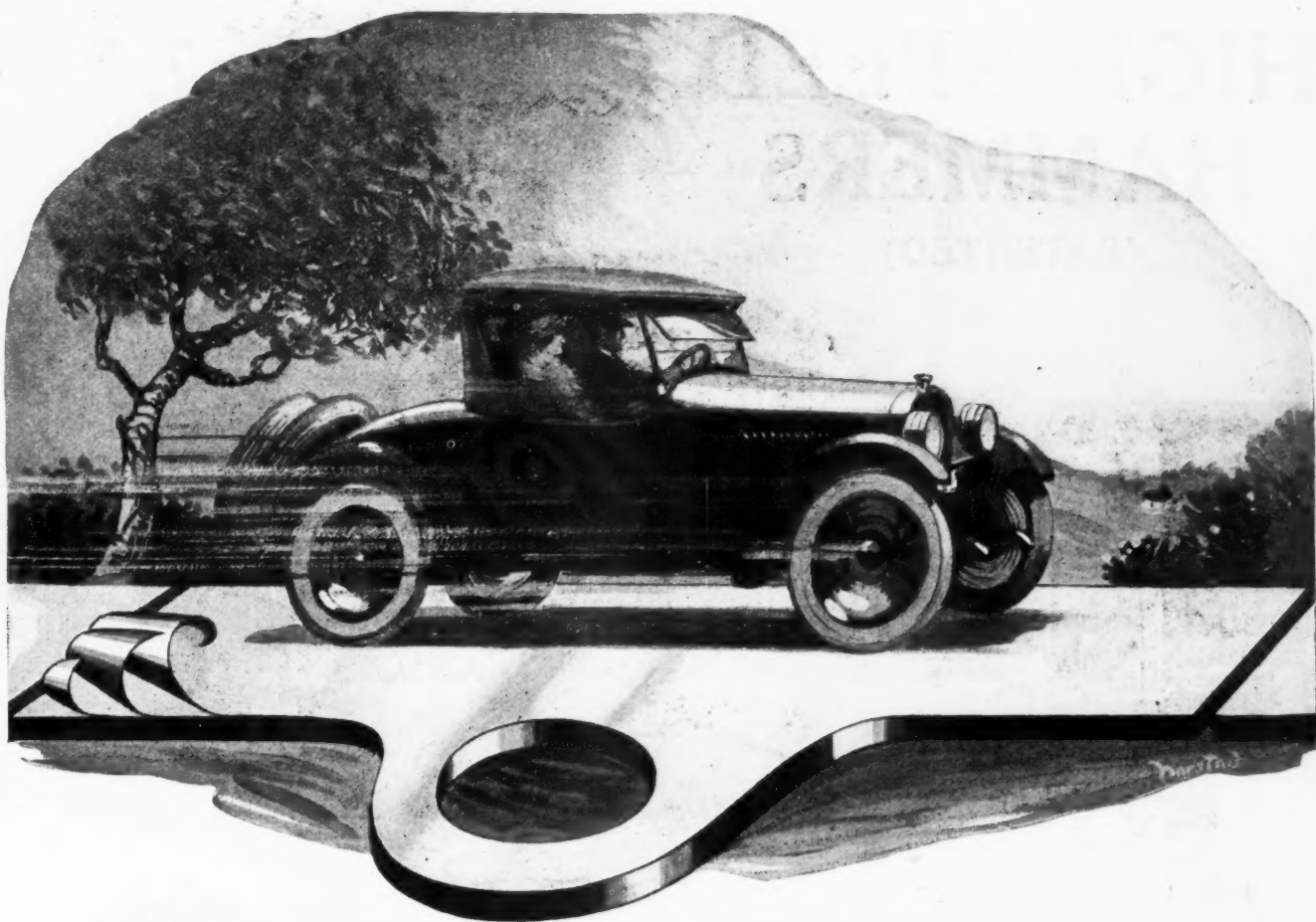
Boston	Detroit	New York
Chicago	Houston	Philadelphia
Cleveland	Kansas City, Mo.	Pittsburgh
Columbus	Milwaukee	St. Louis
	Minneapolis	

Complete stocks carried in all service stations

**DRILLS
GRINDERS**



**BUFFERS
REAMERS**



On the right road ~

CAR manufacturers and engine builders who use Laminum are on the right road—the road to lasting service and owner satisfaction. Nothing else can take the place of Laminum. Not only is roadability assured, but the owner's interests and pocketbook are protected. Laminated shims provide *correct* bearing adjustment not only for the present, but as long as the car lasts. Wise manufacturers keep their cars on the right road, running right with Laminum!

"Just peel 'em down to fit"

LAMINATED SHIM COMPANY, INC., 14th St. & Governor Pl., Long Island City, N. Y.

St. Louis: Mazura Mfg. Co.

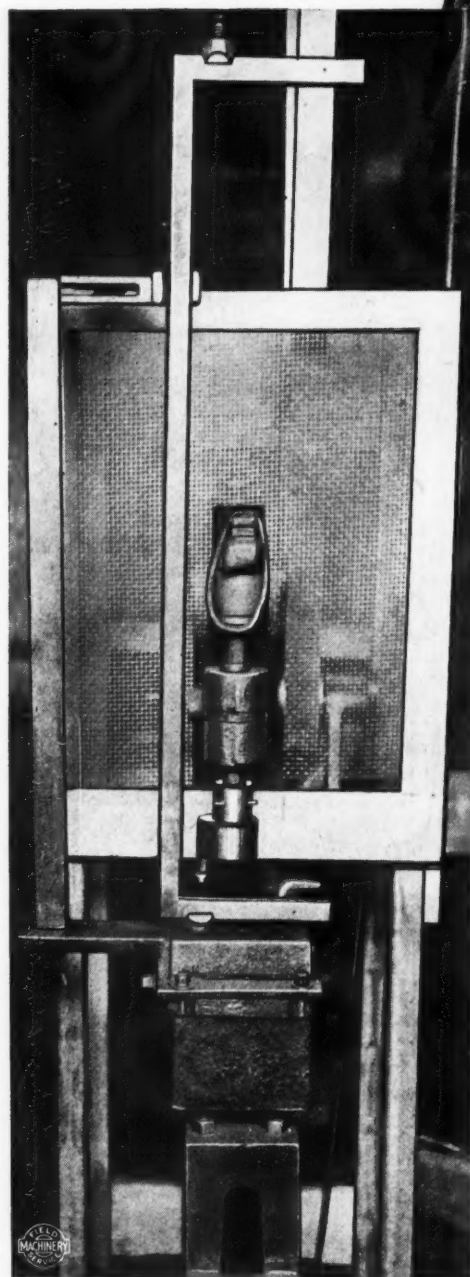
Detroit: Dime Bank Bldg.



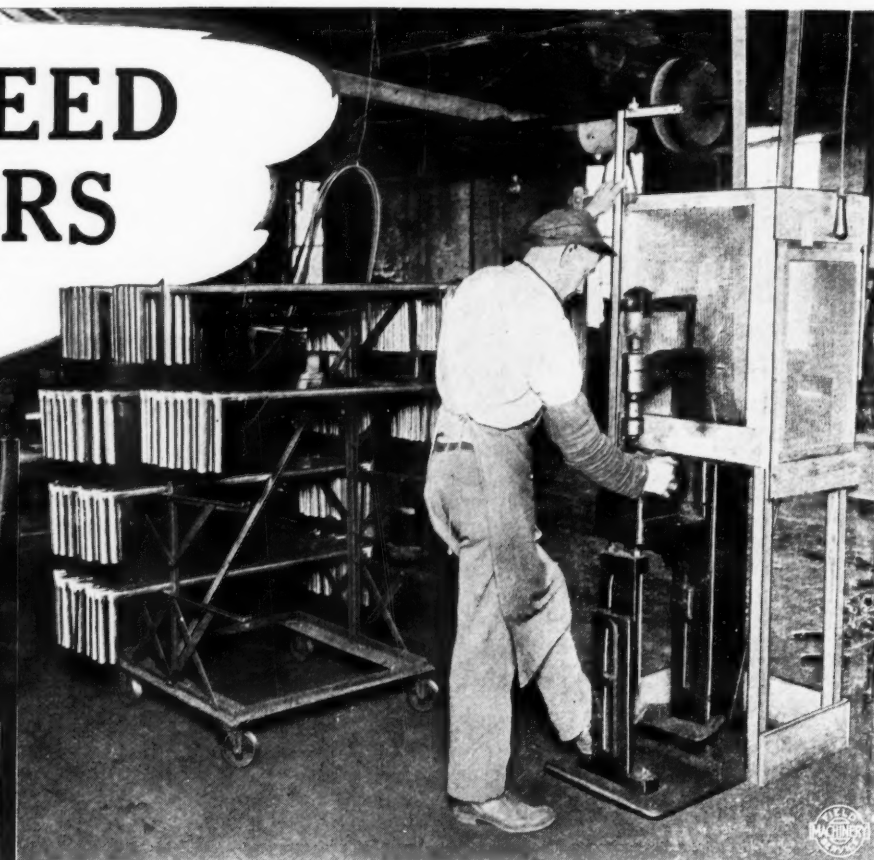
LAMINUM

HIGH SPEED HAMMERS

(PATENTED)



THE PRINCIPLE
IS RIGHT



Heading 800 Rivets per Hour

The High Speed Hammer not only speeds up production; but it is versatile also. For instance, the accompanying photograph shows riveting of cone and stud, the swing bearing, for an automobile wind shield. One end of the stud is put through the cone, screwed into a tapped hole in the frame, and headed over to prevent its backing out.

As the stud is almost in the corner of the frame, and hard to get at, a special sleeve with offset riveting tool was taper pinned to spindle and the usual revolving omitted.

While one man assembles parts the hammer operator rivets two $\frac{3}{8}$ " steel studs per frame. Production is 400 frames, 800 rivets per hour.

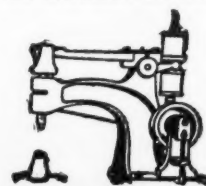
This is one of two High Speed Hammers in the Motors Products Company Plant, Ann Arbor, Mich. Both machines have given satisfactory service for more than 8 years.

Have you a riveting job that is difficult? Want greater production—better riveting? Send us samples for riveting. We'll make suggestions without obligating you.

THE HIGH SPEED HAMMER COMPANY, Inc. ROCHESTER NEW YORK

CHICAGO BRANCH: C. W. Schuchardt, Mgr., 568 West Washington Blvd. AGENCIES: F. O. Stallman Supply Co., 167-173 First St., San Francisco, Agents for Pacific Coast. Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China, Japan and South American Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.

THE HAMMER WITH
THE HUMAN STROKE



Tuarc Disteel Forsyth



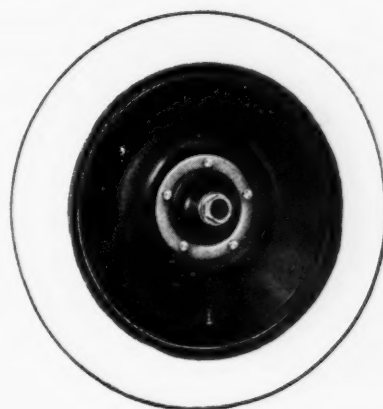
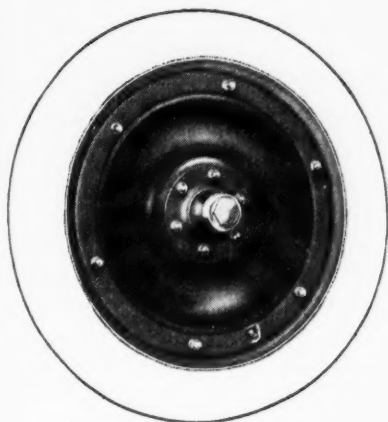
Motor Wheel Products now include the right steel wheels for every type of motor car.

Where demountable rims are desirable there can be no better equipment than Tuarc steel wheels. Disteel wheels are used where a spare wheel is to be carried. Forsyth is the accepted steel wheel for lighter cars.

All three types express the advancement which has resulted in Motor Wheel leadership in steel wheels. Through the tangible betterments it has introduced Motor Wheel has come to supply wheels for more makes of cars than any other wheel maker.

Motor Wheel eminence, together with perfect wheel operation and appearance, add selling value to the car which is equipped with Tuarc, Disteel or Forsyth steel wheels.

MOTOR WHEEL CORPORATION, LANSING, MICHIGAN
Wood Wheels Steel Wheels Stampings





ENDURANCE—

The Criterion of All Motor Car Value

The true standard of motor car value is constantly becoming more clearly defined in the public mind. It was first appreciated in the truck—this fundamentally an investment, with endurance standing practically alone to determine the soundness of the buyer's judgment.

But today, in the passenger motor car where this factor not only determines its span of life and resale value, but the comfort, and quietness of its service, the car's foundation is being accorded deserved consideration.

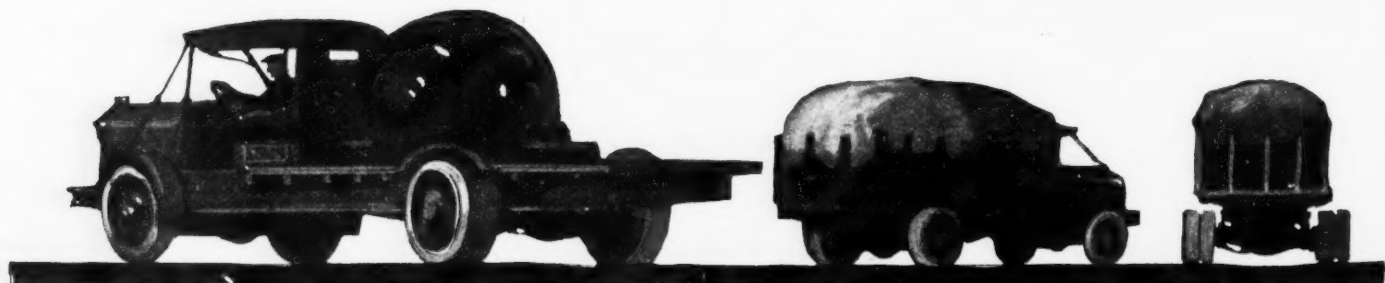
Since the inception of the automobile, when the name of Smith was linked with the first pressed steel frame ever built in America, these engineers have been considered authority, and the product of their skill and experience incorporated in any car furnishes a sound basis for confidence in the investment.

Smith frames are the product of the world's largest and best equipped frame plant. The complete laboratories, modern equipment, and engineering departments provide the utmost in dependability and service as a source of supply for even the largest automobile builders.

A. O. SMITH CORPORATION

Milwaukee, Wisconsin

DETROIT OFFICE: 708 FORD BUILDING



A Prominent Automotive Engineer

A prominent automotive engineer bought W & S Turret Lathes and Tools and paid more for them than was asked for competitive equipment he had investigated.

The W & S Engineer, knowing of this investigation, asked if he would explain why his decision had been for W & S equipment.

And this is what he said:

"I have bought a good many turret lathes in my time, of several different makes, but when I buy a W & S, I know it will come well tooled, begin producing immediately and keep right on producing, and I can forget it. I am willing to pay quite a premium for whatever it is in your machine that gives me that kind of assurance."



The Warner & Swasey Company
Cleveland, U. S. A.



Service—

It can mean much.
It often means little.
But when needed
in connection with
aluminum castings
WERRA
holds the answer.
33 years of ex-
perience backs up
Werra's service.



*We solicit an opportunity
to submit estimates on
your requirements*



Eliminate this Operation

Most Universal Joints require lubrication for best performance. Due to inaccessibility, this detail is most often neglected.

Snead Cushion Drives require no lubrication or attention after installation and therefore troubles subsequent to neglect are eliminated.

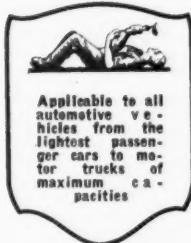
SNEAD & COMPANY

Jersey City, N. J.

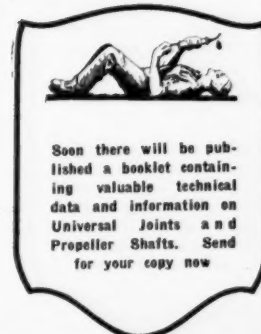
Estab. 1849



A light weight propeller shaft of electrically heat treated alloy steel



Applicable to all automotive vehicles from the lightest passenger cars to motor trucks of maximum capacities

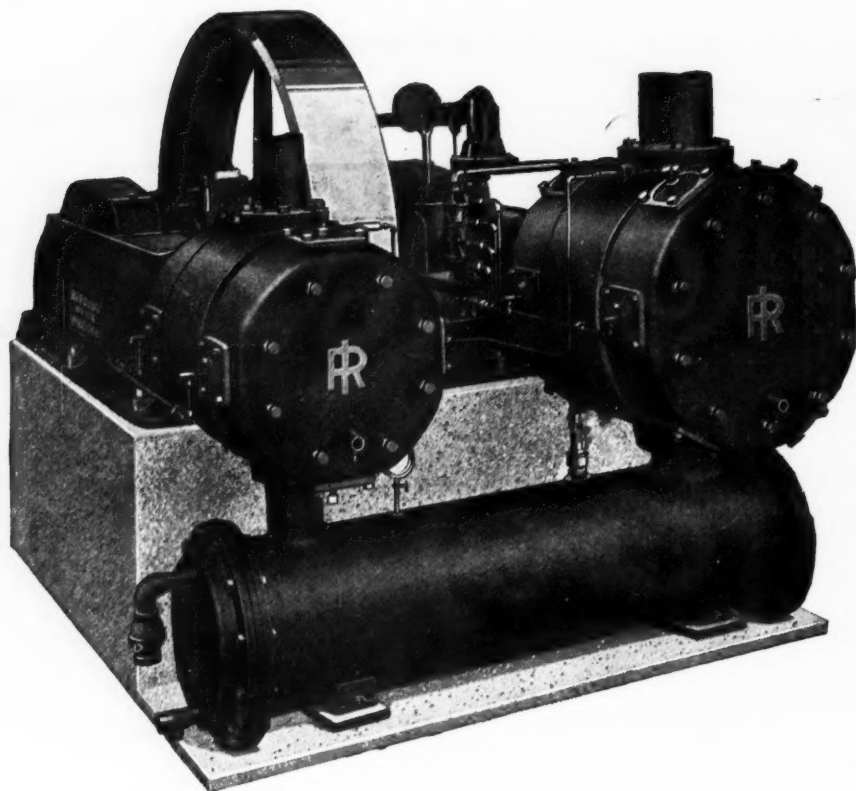


Soon there will be published a booklet containing valuable technical data and information on Universal Joints and Propeller Shafts. Send for your copy now

SNEAD

CUSHION DRIVE

"Takes the Self-Destruction Out of Your Car"



Type "XCB" Compressors

Regulation with the 5-Step Clearance Control automatically governs the output of the compressor and delivers full, three-quarter, one-half, one-quarter or no load. The power required with this method of control is practically in proportion to the air delivered.

The one-piece main frame provides a rigid, enclosed compact frame, making possible quick and easy installation, and guaranteeing correct alignment.

Main bearing housings are a part of the compressor frame and absolutely rigid. They are of large size and are provided with wedge and screw adjustment.

Intercooler, designed to give maximum efficiency, effectively reduces the temperature of the air and condenses any moisture. The complete nest of tubes and baffles can be easily removed for inspection and cleaning.

The bearings, crank pins, crosshead pins and crosshead guides are lubricated by the automatic flood system. The cylinders are lubricated by force-feed lubricator.

Ingersoll-Rand inlet and discharge plate valves operate automatically and entirely independent of any moving valve gear. Large free port and lift openings, adjustment of valve spring tension so as to give the least possible resistance to the intake or discharge of air, insure high compression efficiency.

Send for copy of Bulletin 3042.

Ingersoll-Rand Company

11 Broadway, New York City

Offices in all Principal Foreign and Domestic Cities.

For Canada refer Canadian Ingersoll-Rand Co., Limited.

260 St. James Street, Montreal, Quebec

Ingersoll-Rand

739-C



New Departure Ball Bearings

"THE racing track has had a great part in the evolution of the present day automobile Many lessons will, undoubtedly, be learned and go directly into the manufacture of passenger cars."

It is an impressive fact that every American car which finished at Indianapolis this year was completely equipped with *ball bearings*—practically *all* of them with New Departures.

The demand of racing drivers each year for ball bearings throughout is reflected in the ever-growing interest of designers in "full-jeweled" chassis for passenger car use

—ball bearings to replace types which not only use more power but by very principles of design wear to such an extent that the looseness which results must be taken-up approximately every 5,000 miles or sooner.

New Departure ball bearings do not wear appreciably during the life of the car and, hence, perform *without* adjustment and *without* consequent relaxation of the correct setting of gears and location of the rotating shafts they support.

THE NEW DEPARTURE MANUFACTURING COMPANY

Bristol, Conn.

Detroit

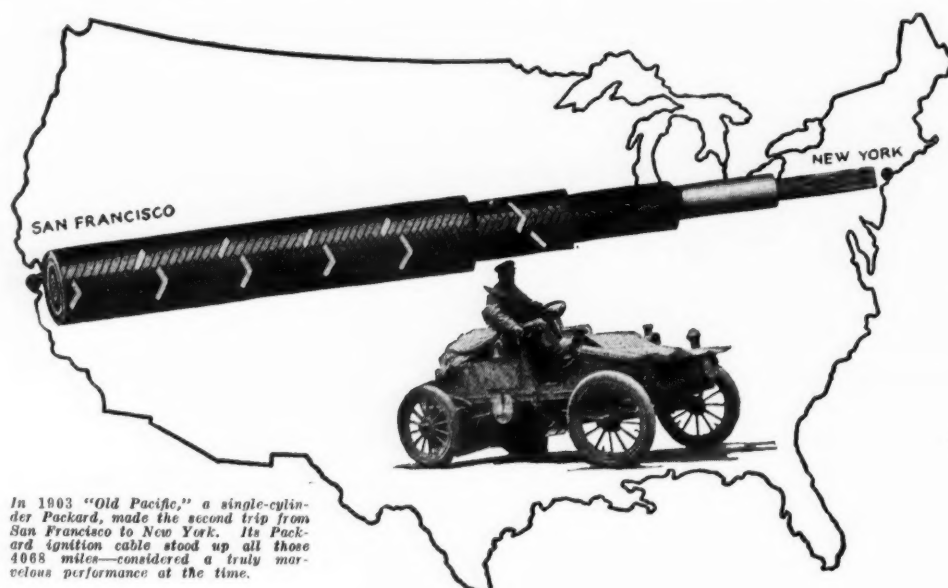
Chicago

56 Victoria St., London, S. W. 1

(The above quotation is from a statement by one of the foremost engineers in the automotive industry.)



The Second Automobile That Drove Across America Used Packard Cable



In 1903 "Old Pacific," a single-cylinder Packard, made the second trip from San Francisco to New York. Its Packard ignition cable stood up all those 4068 miles—considered a truly marvelous performance at the time.

Twentieth Anniversary

JUST twenty years ago—June 20th, 1903—this single-cylinder stock Packard Motor Car left San Francisco for the second transcontinental automobile trip to New York City.

Equipped throughout with Packard Cable—built in a factory now a part of The Packard Electric Company, Warren, Ohio—prominent authorities marveled at the idea of motor-driven vehicles standing up under such a punishing test.

But "Old Pacific" came through a victor.

Climbing the dizzy Sierras, scaling mountain passes of the Rockies, plowing its way through the trackless deserts of Nevada, accomplishing the seemingly impossible, and the *Packard Ignition Cable* stood up the full 4068 miles—a truly remarkable feat at that time.

Today, as twenty years ago, Packard Cable is a part in the Packard Automobile. The improvement in the cable has kept pace with the development of that magnificent car. The quality of the one is, today, in keeping with the quality of the other.

The Packard Electric Company

Warren, Ohio

Rome Radiators



Long Life without Decrease in Efficiency

Rome Radiators offer you exactly that. Many Rome Helical Tube Radiators built in 1909 and 1910 are still giving satisfactory service today.

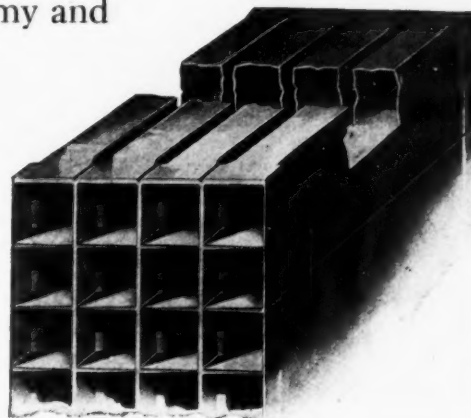
Why do Rome Radiators give such wonderful help in sustaining the reputation of your truck or tractor? The answer—Rome Helical Tube Radiators possess points of superiority which cannot be approached by others. Rome Helical Tube Radiators are *Copper Coiled*. The radiating fin is made in our own mill of pure lake copper. It hugs the tube tightly and cannot stretch or loosen up. The form of the radiating fin insures greatest efficiency.

Rome Straight Flow, Square Tube Honeycomb Radiators employ the same basic principle which gives continuously long and useful life. High Efficiency, sturdiness and distinctive high class appearance have caused this radiator to be specified by both the Army and Navy Air Services.

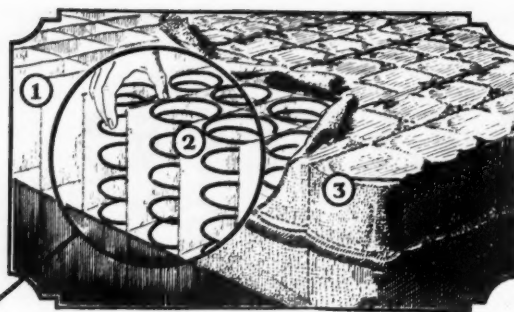
Ask us to tell you more about
Rome Radiators

*Radiators and Cooling Systems for Trucks,
Passenger Cars, Tractors, Railway Cars, Air-
craft, Air Compressors, Stationary Engines,
Etc.*

Rome Turney Radiator Co.
Rome, New York



20 Years of Radiator Experience Are Back of Rome Radiators



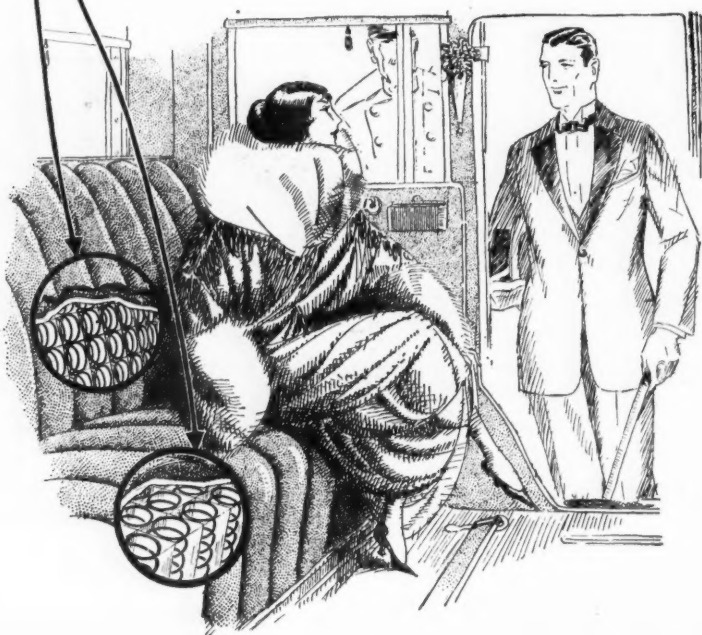
The Nachman Spring Unit Idea

Small springs placed in individual burlap cells, covered and held in place by an outer burlap covering. Stitching across top keeps each spring in place yet allows each individual spring full freedom of action. The combination of all the above exclusive Features form the Nachman Spring Unit.

What's Inside Your Auto Cushions?

THE nationally-advertised NACHMAN SPRING UNITS give a light, yielding comfort that enhances the easy-riding qualities of a motor car. NACHMAN SPRING UNITS are accurately made. In seat and back cushions they make a powerful sales argument and a positive guarantee of long-lived, luxurious comfort.

Nachman Spring Units



SEND templates or blue prints to CHARLES S. MONSON, Director of Sales, Automotive Division, 2113 Dime Bank Bldg., Detroit, Michigan. Sample Units or additional information will be furnished promptly.

NACHMAN SPRING-FILLED COMPANY, HALSTED AT 23rd STREET, CHICAGO

Splitdorf Magneto Ignition

PURDUE UNIVERSITY
LAFAYETTE, INDIANA
SCHOOL OF MECHANICAL ENGINEERING
January 24, 1923.

Splitdorf Electrical Co.,
98 Warren St.,
Newark, N.J.

Gentlemen:

You might be interested to know that your Model SS Magneto is still giving excellent service in our high compression work that we are carrying on in the Engineering Experiment Station at Purdue University. These compression pressures are running from 140 to 175 pounds and we are using commercial gasoline with engine speeds from 200 to 1500 R.P.M.

As compared with the battery systems tried out in these high compression tests, numbering over a thousand, your magneto gave and is still giving the best economy and operating performance. In all of these tests the engine was started by hand cranking and in this respect it has also proved very satisfactory.

Very truly yours,

G. A. Young
Head, School of Mechanical Eng.

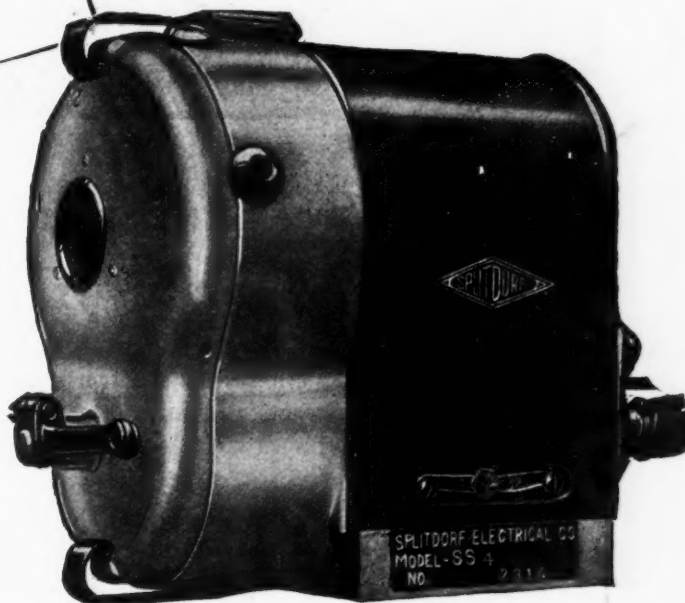
GAT-ML

"Gave the best economy and operating performance"

ONCE more, and this time in engineering tests numbering more than a thousand, Splitdorf Magneto Ignition has proved itself superior to other forms of ignition—proved that it "gave the best economy and operating performance."

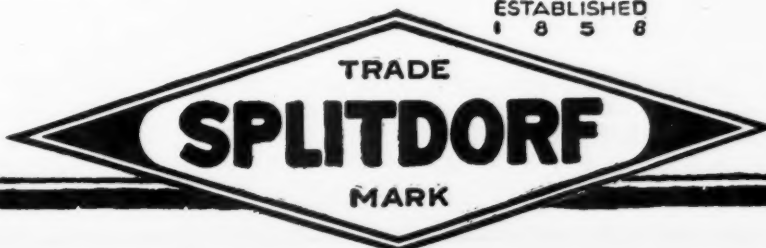
That is why Splitdorf Magnetos are found on so many of the cars, trucks, tractors and engines that are used where the utmost in service, efficiency and dependability is imperative—where the "best economy and operating performance" are demanded!

THE SPLITDORF ELECTRICAL CO.
NEWARK, N. J.



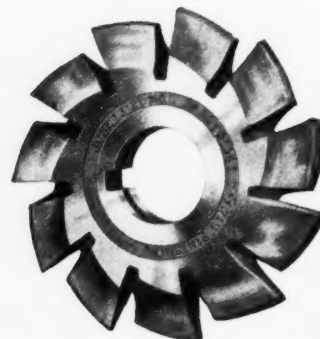
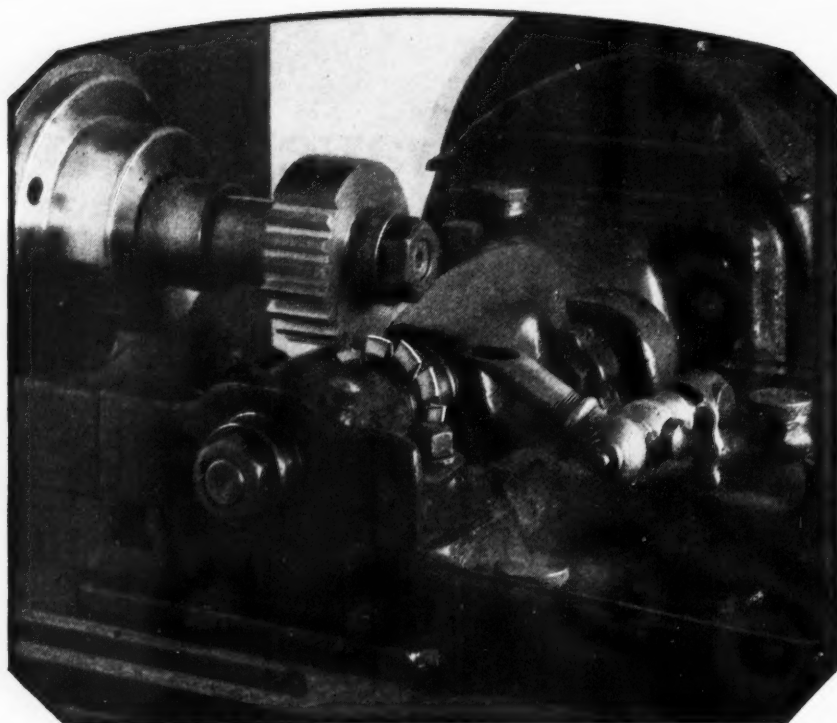
Splitdorf Model SS4 Magneto—
the same model as that referred
to in Mr. Young's letter.

ESTABLISHED
1858



BROWN & SHARPE

GROUND-FORM CUTTERS



Brown & Sharpe Ground-Form Gear Cutters can be secured in sizes from 1½ to 12 Pitch inclusive. In addition to Ground-Form Gear Cutters, we also make to order Ground-Form Spline-Shaft, Sprocket Cutters, etc. Get in touch with our Cutter Department in regard to Ground-Form Cutters.

There are three outstanding advantages in using BROWN & SHARPE Ground-Form Gear Cutters

1. *Cutter Accuracy*—Brown & Sharpe Ground-Form Gear Cutters, as their name implies, have teeth which are ground on the form. Grinding the form corrects all hardening distortions and produces cutters of great accuracy.
2. *Gear Uniformity*—Our method of grinding Ground-Form Gear Cutters gives a positive control of form and allows any Ground-Form Cutter to be accurately duplicated. The ability to secure duplicate cutters makes it possible to produce uniform gears in large quantities.
3. *Increased Production*—Ground-Form Gear Cutters, due to their free-cutting action give an increased production which, by actual test, has proved to be surprisingly great. When you consider that Ground-Form Gear Cutters give increased production along with greater accuracy and uniformity you realize the decided advantage of using this type of cutter.

Write for our new booklet on Ground-Form Cutters.

BROWN & SHARPE MFG. CO.

Providence, R. I., U. S. A.



Automotive Engineers—Send for this booklet. It treats on Ground-Form Spline Shaft and Sprocket Cutters, as well as Ground-Form Gear Cutters. This book shows why Ground-Form Cutters give increased production and greater accuracy and uniformity on gears, spline shafts, and sprockets. Write for your copy today.



At Every Point A Better Pump

Handle: Fine grain hardwood, with shellac finish. Amply large and smooth for a firm, comfortable grip. Nickeled ferrule—no bolts or obstructions to scratch or injure hands.

Barrel: Made of fine grade steel tubing, black enameled. Nickeled cap. Lighter, stronger, more durable than brass.

Hose: Extra heavy rubber tubing.

Hose Connection: Fitted with either standard screw connection or handy "thumb lock" connection. Latter furnished at a slight additional cost.

Wire Foot Base: Wide enough to hold pump firmly in position when in use. Folds back against the barrel when in the tool box. Convenient. Takes up less space.

Ball Check Valve: Prevents all possibility of air leaking from the tire back to the pump. An absolute air seal;

and the wonderful MONROE (patented) Self-Oiling Washer

This washer, the biggest advantage ever built into a tire pump, is located just above the valve leather. Before the pump is assembled it is thoroughly impregnated with a leather-preserving oil. On each up-stroke of the plunger the action of the valve spring compresses the washer and releases a very small amount of oil, which is absorbed by the valve leather. The leather is thus kept so soft and pliant that it readily spreads on every down motion of the plunger, completely filling the barrel and assuring maximum compression. No leakage. No waste effort. Nor will the MONROE dry out as other pumps do, even though it lies unused for months. This proved principle of construction is a feature of only the MONROE Self-Oiler, the pump of longer life and unfailing service—the pump to go into the car you build.

Even with these many advantages, the MONROE is quoted at a surprisingly low figure. Information and prices upon request.

Monroe Auto Equipment Manufacturing Co.
Monroe **Michigan**

Sales Representative to Jobbers Only

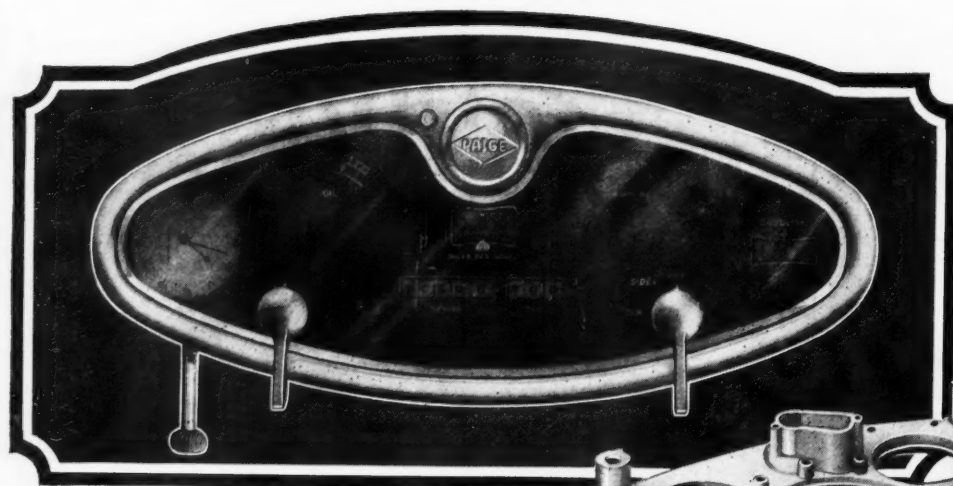
The Fulton Company

Milwaukee, Wis.



"Thumb Lock"
Hose Connection

To Engineers: Send for a MONROE SELF-OILER and give it a thorough test. You'll be convinced when you see what it will do. Standard equipment in many leading cars.



All instruments, switches, dash light, are glass enclosed; switch levers and speedometer and clock stems brought out.

"Milwaukee's" Part in "America's Most Beautiful Car"

NOT least among the many beauties of Paige design, is the smart oval, glass-enclosed Instrument Panel. This practical and attractive innovation is assembled within a pair of 13-inch die castings, "Milwaukee-made" of light, strong white metal and beautifully nickeled.

As the vast possibilities of die casting become better understood, automotive leaders like Briggs & Stratton—who designed and now execute this panel with its switch equipment—are turning more and more to this economical means of production. Milwaukee die castings now appear on a great many leading cars and trucks. Many of these components, like the one pictured above, represented problems of die casting that were not solved over night.

Quite possibly your needs could well be served by substituting precision-made Milwaukee die castings for sand castings at many points. May we exchange specifications?

MILWAUKEE DIE CASTING CO.
Milwaukee Wisconsin

Other "Milwaukee" Products

Die-castings of Aluminum, and white metal (a zinc alloy of uniform molecular construction and moderate tensile strength); Milwaukee bronze-backed and plain bearings; bronze bushings.

MILWAUKEE

DIE CASTINGS and BEARINGS

Products for the automotive industry

Mayari Pig Iron

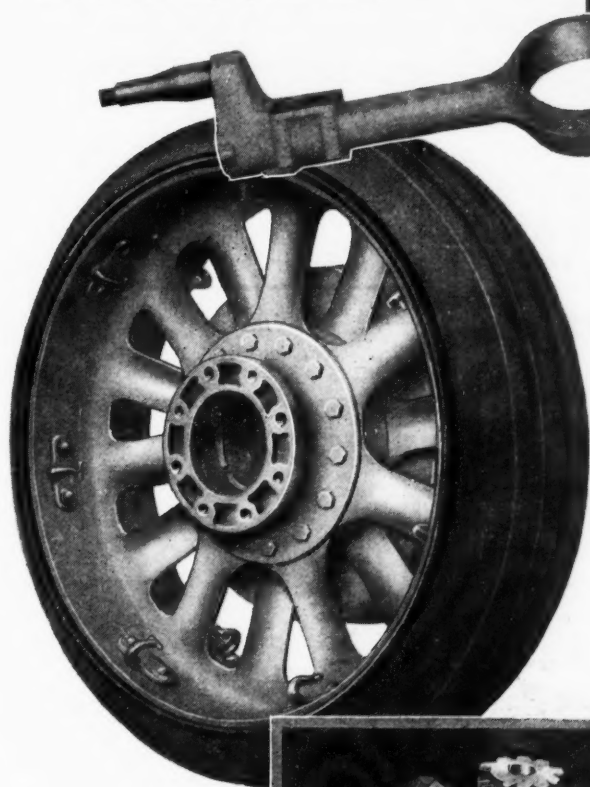
Mayari Pig Iron, with its natural nickel-chromium content, gives remarkable wear-resisting qualities in motor castings. The castings machine readily, despite their high Brinnell hardness, take a smooth polish, and withstand heat.

Drop Forgings

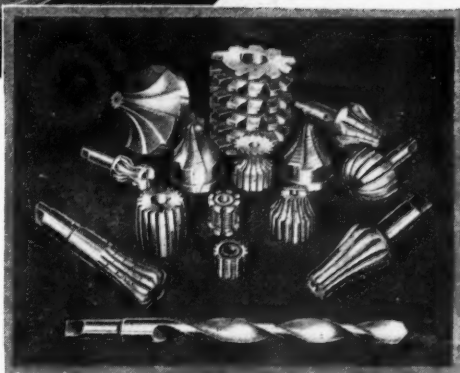
Large forge shops, combined with complete steel-producing facilities, enable Bethlehem to supply drop forgings in any quantity, and to meet any specifications.



Above: Four-cylinder engine with cylinder head, block and pistons made with Mayari Pig Iron. At left: Forged automobile bus axle housing; weight, 355 pounds.



Above: Bethlehem Rolled Steel Truck Wheel. At right: Milling cutters and drill made of Bethlehem Special High Speed Tool Steel



Rolled Steel Truck Wheels

The Bethlehem method of making a truck wheel from a rolled steel I-beam results in a wheel that combines great strength and durability with light weight and resiliency.

Automobile and Motor Truck Rim Sections

These rim sections are rolled true and accurately to dimensions, and have exceptionally smooth finish. Bethlehem is prepared to furnish all the standard rim sections; other sections will be manufactured by special arrangement.

Tool Steels

Bethlehem Special High Speed Tool Steels take heavy cuts at high speeds and still retain the full efficiency of their cutting edges. Bethlehem manufactures a tool steel for every purpose.

Fly Wheels

Fly Wheels made by a combined forging and rolling process render especially satisfactory service. By this process a more uniform density of metal is obtained, insuring perfect balance with strength. Fly Wheels made by this process can be applied to any speed motor with safety. Starting and Clutch efficiency is greatly increased.

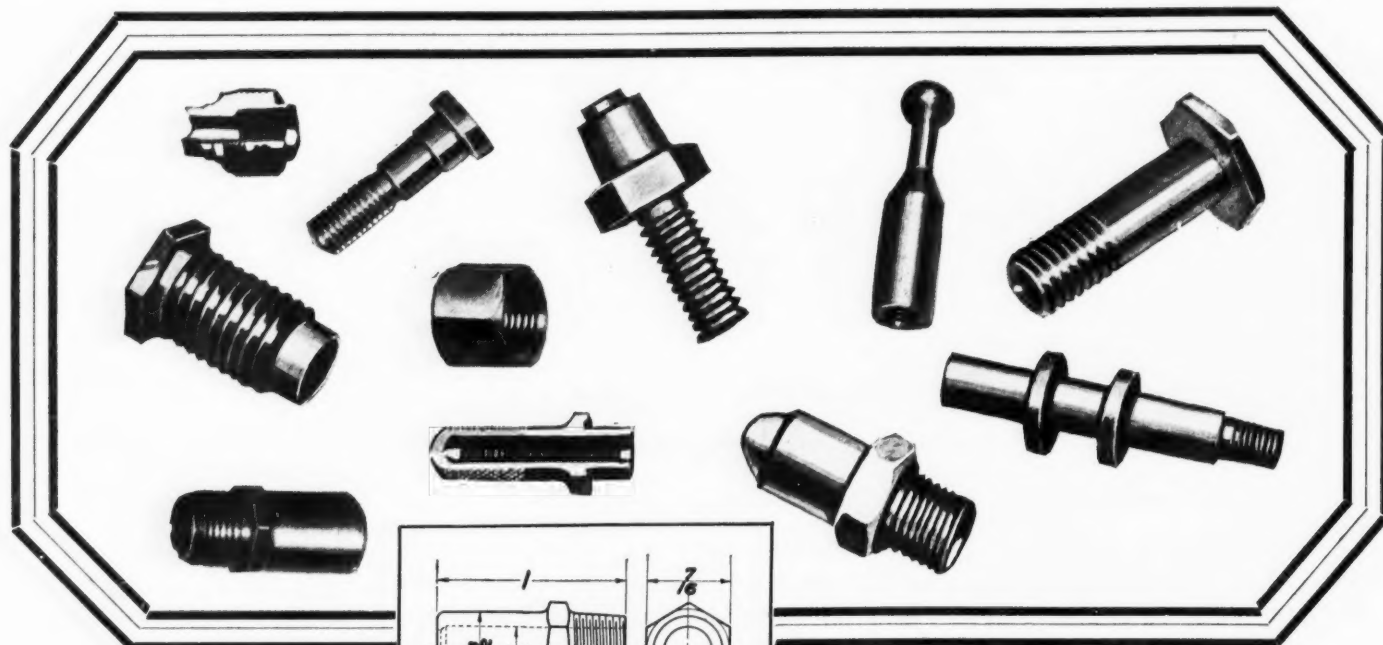
BETHLEHEM STEEL COMPANY

Bethlehem, Pa.

Sales Offices:

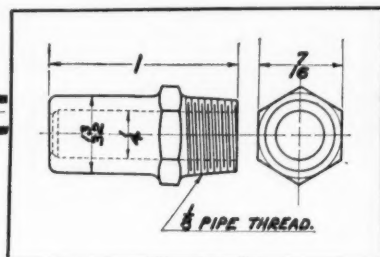
New York	Baltimore	Buffalo	Cleveland
Boston	Washington	Pittsburgh	Detroit
Philadelphia	Atlanta	Cincinnati	Chicago
St. Louis		San Francisco	

BETHLEHEM



Material, Brass $\frac{7}{8}$ in.
hex.

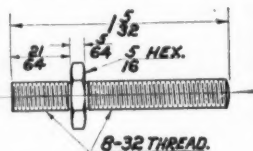
Net production 580 per
hour



Work Like This —at these unusual time figures

Automotive screw-machine parts turned out automatically in one-fifth the usual time of ordinary methods. And with no loss of accuracy. The DAVENPORT is different—has INDIVIDUALLY ADJUSTABLE FEED to the tools.

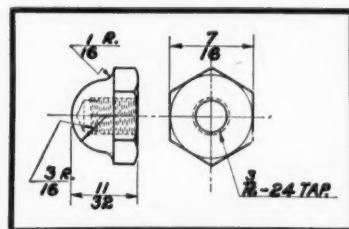
By this means, each of the many cutting-tools is always cutting metal TO THE LIMIT. There is no "longest operation"—every cut in the five spindles finishes approximately at the same time, the work-carrying head indexes and a completely finished piece drops into the chute, instead of into the chips. At each indexing, a finished piece. Despite this great SPEED, the Davenport produces ACCURACY.



Material, Brass $\frac{5}{8}$ in.
hex.

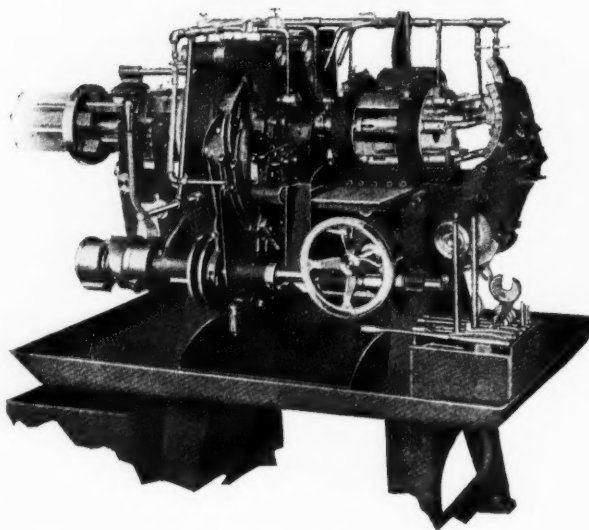
Net Production 480 per
hour

Capacity $\frac{5}{8}$ " round, $\frac{9}{16}$ "
hex. Any length up to $2\frac{1}{2}$ ".



Material, Brass $\frac{7}{8}$ in.
Hex.

Net Production 1440 per
hour



DAVENPORT

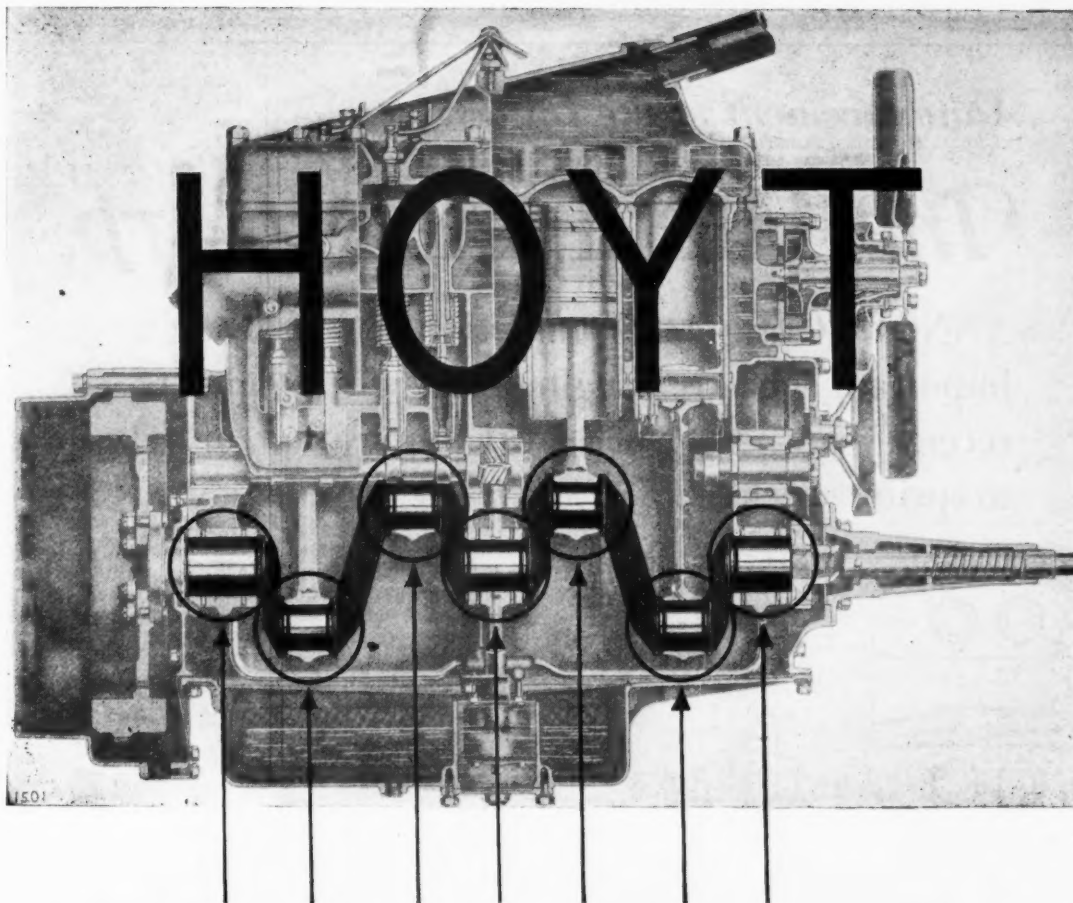
5 Spindle Automatic

DAVENPORT MACHINE TOOL CO., INC.,

Rochester, N. Y.

REPRESENTATIVES:

Notch & Merryweather Machy. Company, Cleveland, Cincinnati, Detroit, Pittsburgh
Vonnegut Machy. Company, Indianapolis, Indiana
Mr. J. H. Glover, 32 N. Clinton Street, Chicago, Ill.
Henry Prentiss & Company, New York City, N. Y.



BUILT FOR LASTING SERVICE

Hoyt Bronze-backed Babbitt-lined Bearings are built of the very finest materials that can be bought, and much of the machinery used for obtaining a perfect metal mixture has been specially designed by the Hoyt Company. This combination of highest quality materials and unusually efficient manufacturing methods makes it possible for Hoyt Bronze-backed Babbitt-lined Bearings to give longer-than-usual service.

All Hoyt Bearings are made to conform exactly to special specifications. S.A.E. mixtures and special combinations can always be delivered in record time.

This Booklet Will Help You—Send for a Copy

Send for a copy of our booklet on Babbitt-lined Bearings—it contains 24 pages of information that should be helpful to anyone interested in bearings and bearing design.


Other Hoyt Products

Bronze - backed Babbitt - lined Bearings and Bushings
All-bronze Bushings
Stick Bronze, Cored or Solid
Brass and Aluminum Castings
Rolling Mill Bearings
Babbitt Metals
Die Castings of Zinc Base, Tin Base and Special Alloys
Sheet Block Tin
Tin Pipe
Lead Pipe
Special Casting Metals
Sheet Lead
Lead Washers
Tape Lead
Lead Sleeves
Lead Wool
Lead Wire
White Copper Stamping Metal
Casting Metals
Solder (bar and wire)

HOYT METAL COMPANY

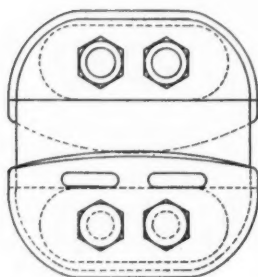
Boatmen's Bank Bldg., St. Louis, Mo.

New York Toronto Chicago London Detroit

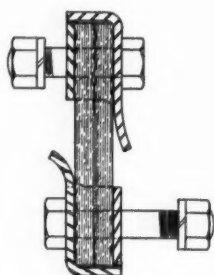
 Established 1873 **HOYT**
Bronze-Backed Bearings

*Announcement to the Industry***The BELFLEX Corp.**

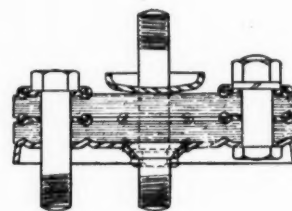
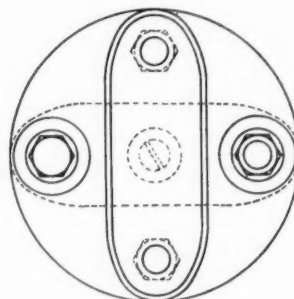
ANNOUNCES—The completion of one of the most important chassis Engineering developments in recent years—the successful application of fabric to spring shackles.



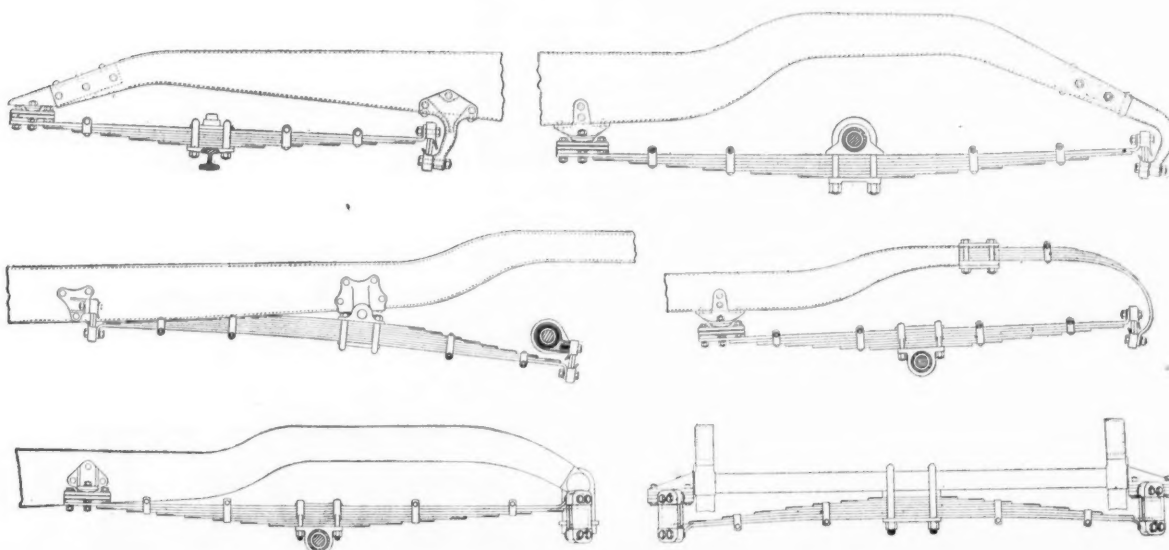
The Tension Shackle, shown in the above illustration, can be supplied in various sizes to fit any weight of car. It is the result of over three years of development work and there is a valid reason for every detail. It is used at the rear ends of the springs.

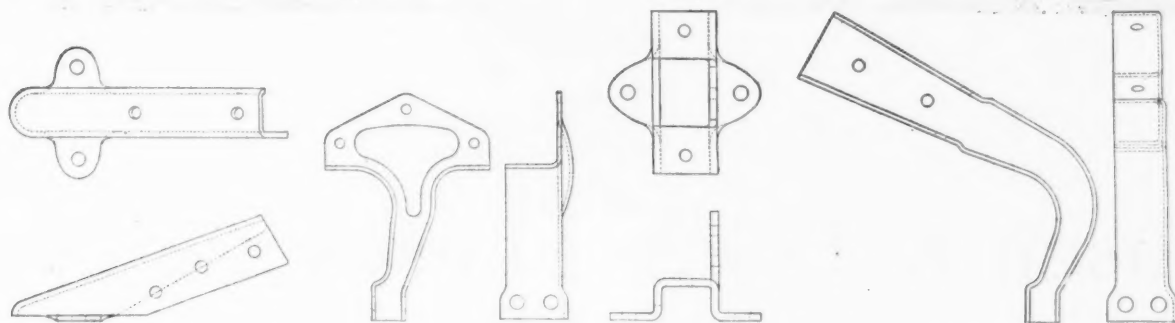


The Pivot Shackle, shown below, is used at the front ends of the springs. In addition to its other advantages it takes the twisting action produced by uneven deflections away from the main leaf of the spring, giving the spring greater flexibility and increasing its life.

**Belflex Fabric Spring Shackles**

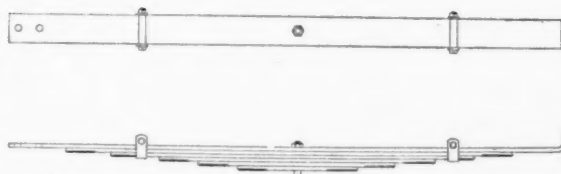
It is possible to use Belflex equipment on all types of spring suspension. Below are illustrated Semi-elliptic, Cantilever, $\frac{3}{4}$ Elliptic and Platform Springs with Belflex equipment:





The Belflex spring shackles are the *only* shackles which permit the use of stamped frame brackets. These brackets, illustrated above, are strong, light, inexpensive, easy to install and improve the appearance of the car.

The elimination of spring eyes and eye forming operations simplifies the springs and reduces their cost. A semi-elliptic spring for Belflex Shackles is shown on the right.



Advantages Gained by Use of Belflex Fabric Spring Shackles

1. Low cost, ease and simplicity of installation in production.
2. Elimination of from 12 to 16 lubricating points from the average chassis.
3. Substitution of noiseless fabric insulation for metallic contact between the sprung and unsprung parts of the car.
4. Cushioning the Hotchkiss drive.
5. Complete elimination of the squeaking and rattling bolts and bushings heretofore identified with spring shackles.
6. Permanent silence of the chassis in operation, due to absorption of minor vibrations and road shocks.
7. Elimination of hard riding and spring eye breakage due to improper shackle adjustment.
8. A longer period of operation without replacement.
9. Complete elimination of attention of any sort.
10. Low cost, ease and simplicity of renewal.

Belflex Engineers are ready to aid you in the design of equipment to conform to your chassis requirements. For further information write

The BELFLEX Corp.

AUTOMOTIVE PRODUCTS

366 Madison Ave., New York City

Patents on Belflex Fabric Spring Shackles have been granted, and others are pending, in the U. S. and other countries



Bausch & Lomb Lenses are Legal Wherever There are Headlight Laws

THE Bausch & Lomb Headlight Lens is scientifically designed in accord with fundamental optical laws; and built by an organization which has for seventy years specialized in the making of the finest lenses.

It is the logical lens for car equipment because it complies with the headlight laws of *all* States.

Its clear, bright beam of light covers the full width of the road, even on curves, and makes objects plainly visible up to five hundred feet.

As the light is thrown down on the road, where it belongs there can be no dangerous glare to confuse approaching motorists and pedestrians.

And beside being optically perfect, the Bausch & Lomb Lens is handsome—it is a distinct addition to the good appearance of any car.

Write for details of our equipment proposition.

Bausch & Lomb Optical Company

Rochester, N. Y.

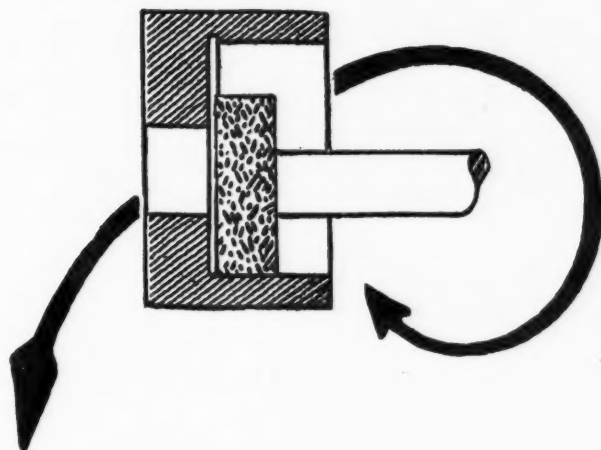
NEW YORK WASHINGTON CHICAGO SAN FRANCISCO LONDON

Leading American Makers of Photographic Lenses, Microscopes, Projection Apparatus (Balopticons), Searchlight Reflectors, Stereo-Prism Binoculars, Telescopes, Magnifiers, Automobile Lenses and Other High-Grade Optical Products

**BAUSCH
&
LOMB**



**MOTOR
LENS**



INTERNAL GRINDING IN THE TOOL ROOM

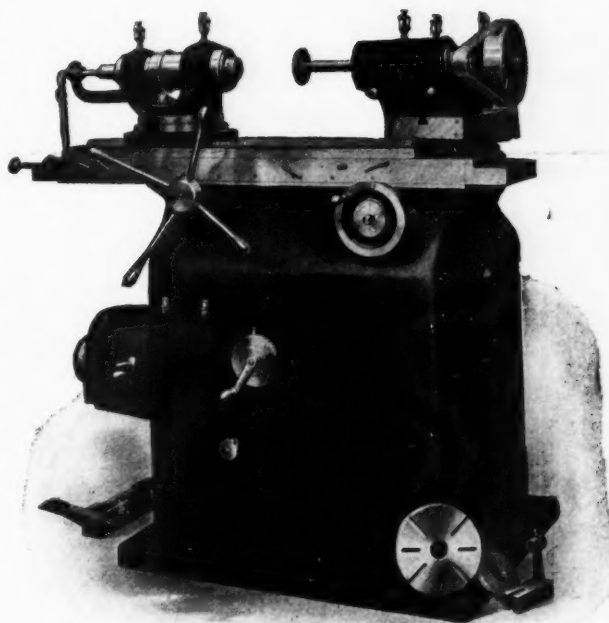
An internal grinder for the TOOL ROOM must be something more than a production machine. It must have range—handle the larger job as well as the small delicate one. It must be quick and easy to set up whether the job is simple or difficult.

For blind hole grinding the table travel must be positive in length, as the slightest over-travel will ruin both wheel and work.

The Rivett No. 106 has all the features to make it the finest internal grinder for the TOOL ROOM.

The table travel of the Rivett No. 106 is positive, controlled by a taper cam, an exclusive feature of Rivett Grinders. The table travel is regulated with such exactness that each succeeding stroke is exactly the same length as the preceding one.

Before buying ANY toolroom grinder, look into the RIVETT. Write or telephone nearest dealer whose name is listed below.



PROMPT DELIVERY—RIGHT PRICE.

RIVETT

Rivett Lathe and Grinder Corp. — Brighton, Boston, Mass.

Branch Offices:

6526 Cass Ave., Detroit

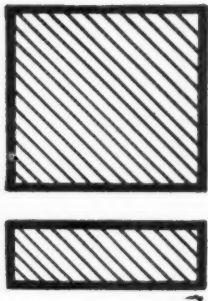
149 Broadway, New York

Domestic Agents: Purinton & Smith, Hartford, Conn.; Brownell Machinery Company, Providence, R. I.; Homer Strong & Co., Inc., Rochester, Buffalo, Syracuse, Albany, N. Y.; W. E. Shipley Machy. Co., Philadelphia, Pa.; Somers, Fittler & Todd Co., Pittsburgh, Pa.; Cleveland Tool & Sup. Co., Cleveland, O.; E. A. Kinsey Co., Cincinnati, O.; Indianapolis, Ind.; National Sup-

ply Co., Toledo, O.; Consolidated Machine Tool Corp. of America, Chicago, Ill.; Blackman-Hill-McKee Machy. Co., St. Louis, Mo.; Portland Machy. Co., Portland, Ore.; Hallidie Machy. Co., Seattle, Wash.; F. O. Stallman Sup. Co., San Francisco, Los Angeles, Cal.; F. E. Satterlee Co., Minneapolis, Minn.; Peden Iron & Steel Co., Houston, Texas; Smith-Courtney Co., Richmond, Va.; Walraven Co., Atlanta, Ga.

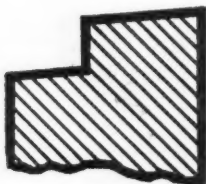
FOREIGN AGENTS:

H. W. Petrie, Ltd., Toronto, Ont., Canada; Williams & Wilson, Ltd., Montreal, Canada; Fenwick Freres & Co., France, Belgium, Switzerland, Italy, Spain, Portugal; Buck & Hickman, Ltd., London, Glasgow, Manchester, Sheffield, Birmingham; Benson Brothers, Sydney, Australia; Yamatake Co., Tokio.



*Compare
These Areas*

Given equal pressure on both, on which would the stress be least per square unit? The upper is the projected area of a Cotta clutch-jaw's bearing face. The lower is that of a conventional gear-tooth.



*—and These
Profiles*

Through which would sudden pressure be most efficiently transmitted to the base? The upper is that of a Cotta clutch-jaw. The lower is that of a conventional gear-tooth.



For

TRUCKS—TRACTORS

MOTOR BUSES

INDUSTRIAL LOCOMOTIVES

GASOLINE RAIL CARS

and all heavy duty service.

COTTA CLUTCH-JAWS receive the first shock of the combat between the motor's power and inertia plus gravitation. So they are armed with large area and "bracket" profile; with a mass many times that of a gear tooth.

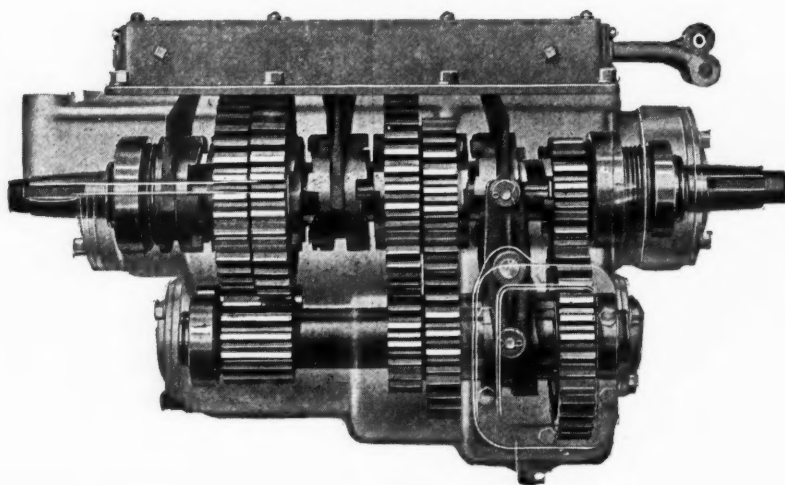
They are the vanguard of the struggle, and Cotta gear teeth are always in full mesh, ready with full strength for their burden.

*no Cotta transmission
has ever stripped a gear.*

COTTA TRANSMISSION CORPORATION

2300 Eleventh Street

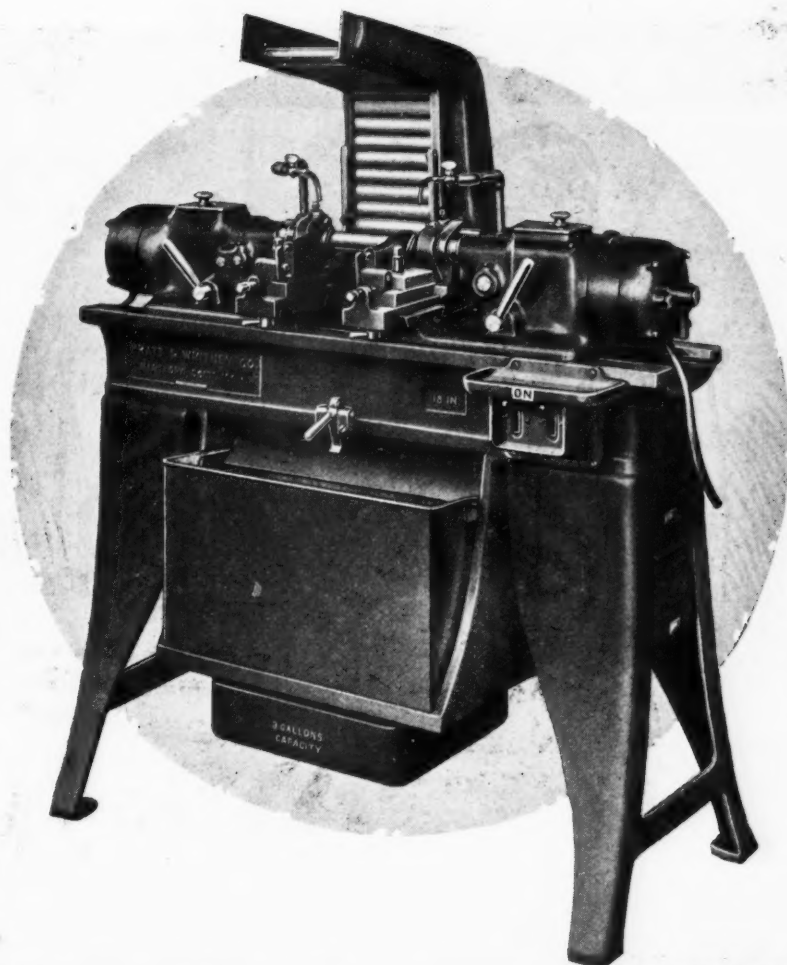
Rockford, Ill.



COTTA

TRANSMISSIONS

GEARS ALWAYS IN MESH



And now—

Lathe Work May be centered ENTIRELY AUTOMATICALLY—4 to 10 pieces per minute

A NEW Pratt & Whitney high-production machine—takes shafts up to 18" in length and centers both ends at once. Not only is the actual feeding of the drills automatic, but all handling of the work—putting it into the machine and removing it—IS ENTIRELY AUTOMATIC. An unskilled operator can keep the magazine of several machines supplied with work. This and removing work-pan when full, his only duty—and grinding the drills from time to time.

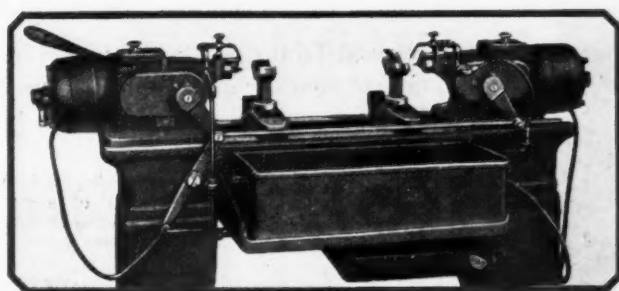
Stops are provided which can be set either to feed the drills in to a predetermined distance from each other or to produce the same size center in each piece regardless of variations in length of the work.

Circular No. 297 and performance record on work similar to yours mailed on request.

PRATT & WHITNEY CO.

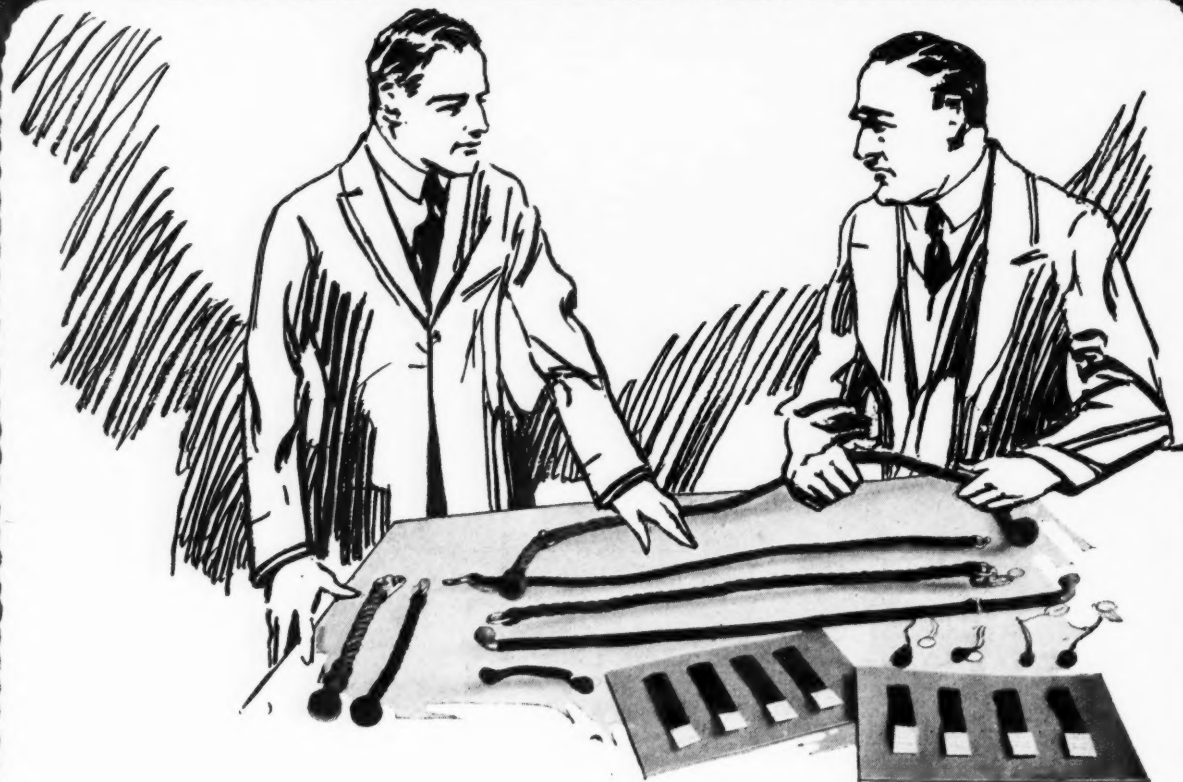
WORKS—HARTFORD, CONN.

GENERAL OFFICES—111 BROADWAY, NEW YORK



The P. & W. HAND FEED Centering Machine. Same operation as automatic machine. Hand-lever feed operates both spindles simultaneously, also an oil-pump for lubricating drills. For shafts longer than 18", one head may be removed and one center at a time drilled.

PRATT & WHITNEY



In Selecting Trimmings For Your Closed Models

STRIVE for a harmonious blending of the color and fixture combinations.

When choosing laces, curtain cords and tassels, hand ropes, robe rails or other trimmings—make sure they can be artistically placed to harmonize with the decorative theme of the interior.

Schlegel Trimmings, tastily placed by car artists and designers, will make the interiors of your car more beautiful, pleasing and attractive. All the trimmings are of fast dyes and will last, until completely worn out, in their original color.

We will be glad to co-operate with you in the selection of appropriate trimmings—trimmings that you will find not only ornamental, but thoroughly practical.

THE SCHLEGEL
MANUFACTURING COMPANY,
ROCHESTER, N. Y.

SCHLEGEL INTERIOR DECORATION

*Broad Laces
Pasting Laces
Seaming Laces
Wind Laces
Curtain Silks
Curtain Tassels
Curtain Cords*

*Hat Racks
Robe Rails
Luggage Carriers
Arm Rests
Speaking Tubes
Pull-to-handles
Curtain Bands*



The Logangear is made of a bar of special alloy steel, shaped to a ring, heat treated and electrically welded at the joint. It has no weak point. The gear teeth are then cut to accurate pitch and given a scientific correct chamfer which insures a perfect mesh with the starter pinion. The finished ring is then hardened.

The teeth are rounded to an angle of 45°—a design which was developed in collaboration with one of America's greatest Starter manufacturers—and which affords quietness of mesh and maximum strength in each tooth.

Batter proof gears for your flywheels—

Flywheel gears cast integral with the flywheel are a vital source of trouble and owner dissatisfaction. Cast iron is too brittle—too easily stripped and battered to be used where the strain is so severe.

By adopting Logangears as standard equipment you can eliminate this faulty construction—and that with only a slight increase in production costs.

It is simply a matter of casting your flywheels without gears and then shrinking on the Logangear rings.

Make your flywheel gears batter-proof.

**KAUFFMAN METAL PRODUCTS
COMPANY**

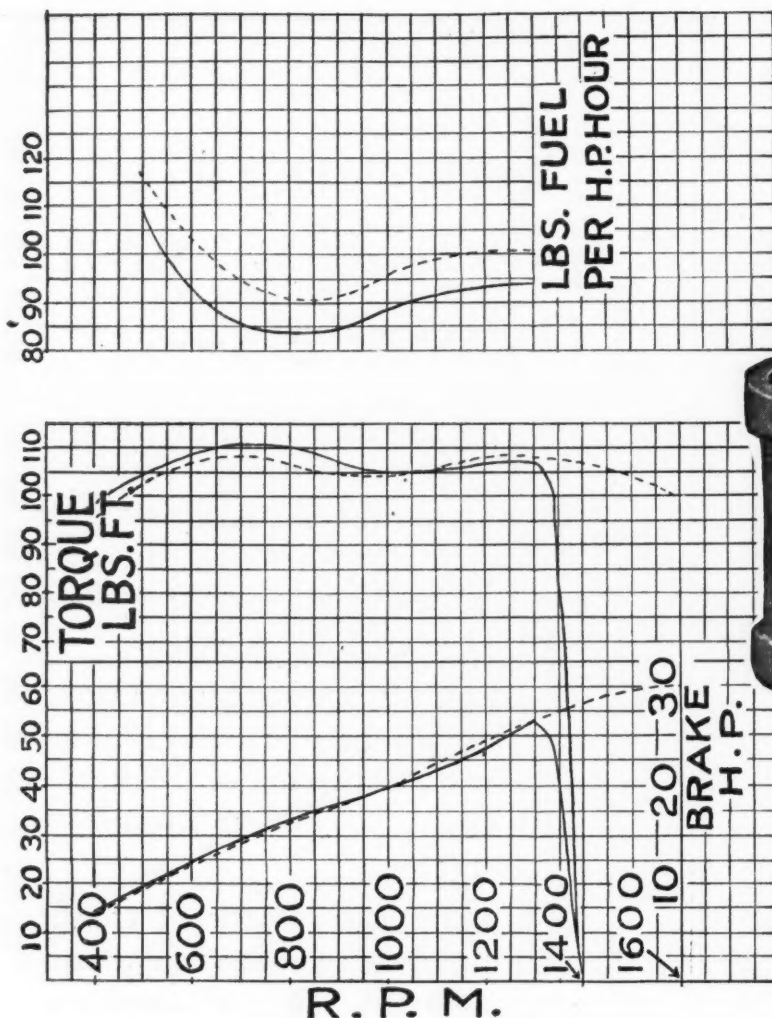
Bellefontaine

Ohio

Send your blueprints for an estimate and ask for the Logan catalog of standard sizes.

LOGANGEARS





*Economy, efficiency
and durability*



With governor _____

Without governor ...

This is a composite
power curve.

Dynamometer proof of K. P. Efficiency

**Controlled by
the vacuum
and not by
velocity.**

*Simple and automatic
in operation, with no
gears or other compli-
cated parts.*

*Requires no lubrica-
tion. Installed be-
tween carburetor and
intake manifold. Can
be locked against tam-
pering and will never
stick.*

The K. P. Governor utilizes the vacuum as its controlling factor rather than gas velocity.

Thus we get quick opening and acceleration (as the power curve indicates) without restriction.

The K. P. Governor is thoroughly efficient. It protects the truck against overspeeding without loss of engine power at governed speed.

It is staunchly built and durable and because of the simplicity of its design, it can be furnished to truck manufacturers at the lowest possible price.

Test the K. P. Governor in your own plant on one of your own engines.

Ask for a Governor and make your own demonstration.

K. P. Products Co., Inc.
50 Pine St., New York City

K.P. Governor
GOVERNS WITHOUT LOSS OF POWER

The average distance of the earth from the sun is 93,000,000 miles. This represents the distance over which PALMER FOLDED Brake Lining gave 100% service during the year past.



93,000,000 Miles

PALMER FOLDED Brake Lining Travelled this distance on Taxicabs during the last 12 months

The great durability, high braking power and low maintenance cost of PALMER FOLDED on taxicabs all over the country made possible this enormous mileage.

Exclusive on Yellow Cabs

The experience of the Yellow Cab Co. in Chicago is illuminating. They tried out many reputable makes of brake lining for over a year with the result that they now use PALMER FOLDED exclusively not only on Chicago cabs but on all cabs made and sold by Yellow Cab Manufacturing Company.

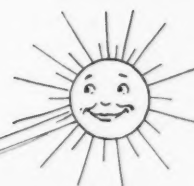
Private Owners Are Interested

More and more as the automobile has entered the business man's daily life he is checking up on what a car costs him. Owners and dealers alike judge a car by its unseen as well as its apparent features, and with every half million cars that are added to the roads the feature of brake lining becomes more vital to every car maker and driver.

Special to Car Manufacturers:

Have you standardized on PALMER yet?

PALMER FOLDED is destined to become as familiar a name in future car sales as is many other an item of nationally known equipment. Are you capitalizing the added feature of safety, service and economy which the standardization on PALMER FOLDED will give? Why wait to see what others may do? It's better to trust your own judgment and act now.



Yellow Cab Company

PHONE FOR A YELLOW CABINET 6000 OFFICE 57-65 East 21st Street CHICAGO OFFICE TELEPHONE CABINET 7343

May 18th, 1922.

Palmer Equipment Corporation,
526 Railway Exchange Bldg.,
Chicago, Ill.

Gentlemen:-

With reference to the use of your "PALMER" Folded Brake Lining on our Yellow Cabs, please be advised that up to the time of adopting your material as standard, we tried many reputable makes of lining on the market, but found after exhaustive tests, lasting over a period of more than a year, that we obtained from two to three times the mileage from the use of your "PALMER" Lining.

The adoption of this material has eliminated the once familiar squeaking of Yellow Cab brakes, and has cut down our labor for brake maintenance to a very marked degree.

Yours very truly,

YELLOW CAB COMPANY.

R. H. Stouffer
General Superintendent.

Phone for a  Cabmet 6000



PALMER ASBESTOS & RUBBER CORPORATION

Manufacturers

Railway Exchange Building
Chicago

1181

Automotive Industries
May 31, 1923

Production Efficiency Offsets Rise in Wages and Material Prices

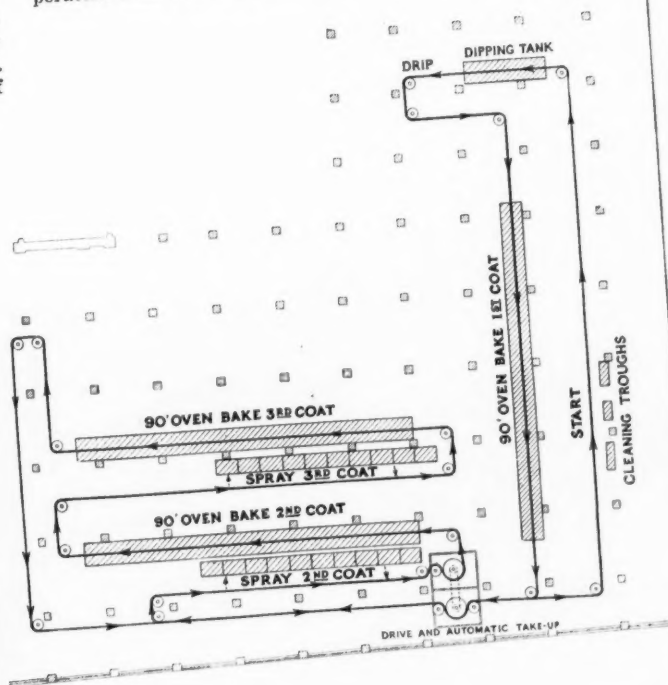
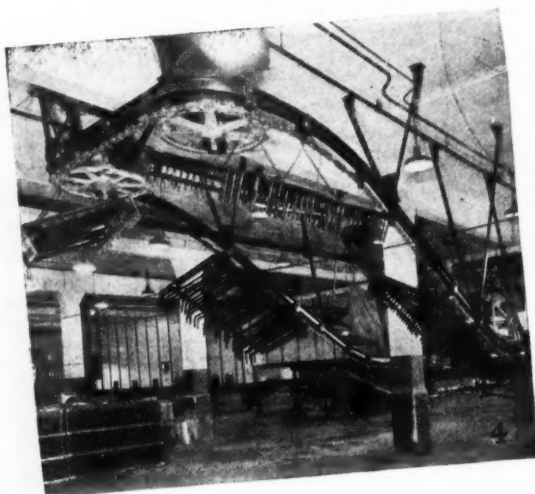
Overhead conveyor installation cuts unit cost of enameling windshield frames at Ternstedt plant. System to be extended to manufacturing departments. Pressure ventilation provides pleasant working conditions. Quality of product improved.

BY installing an overhead conveyor chain system for handling windshield frames in the enameling department, the Ternstedt Mfg. Co. has saved enough to offset a 10 to 40 per cent increase in materials and a 15 per cent increase in wages. Reduction has been effected in the labor necessary to truck parts about the plant. Fewer pieces are rejected and a more constant output per labor unit has been attained.

So successful has the system been that the Ternstedt company intends to extend it to other departments handling even smaller parts. The installation of this Miller & Hurst overhead conveyor chain has resulted, not only in the economies mentioned, but in providing an incomparably brighter, cleaner shop, which has undoubtedly had a considerable psychological effect on the employees. It has, furthermore, made possible the employment of

women for handling most of the work, whereas men were needed previously for a great many of the operations.

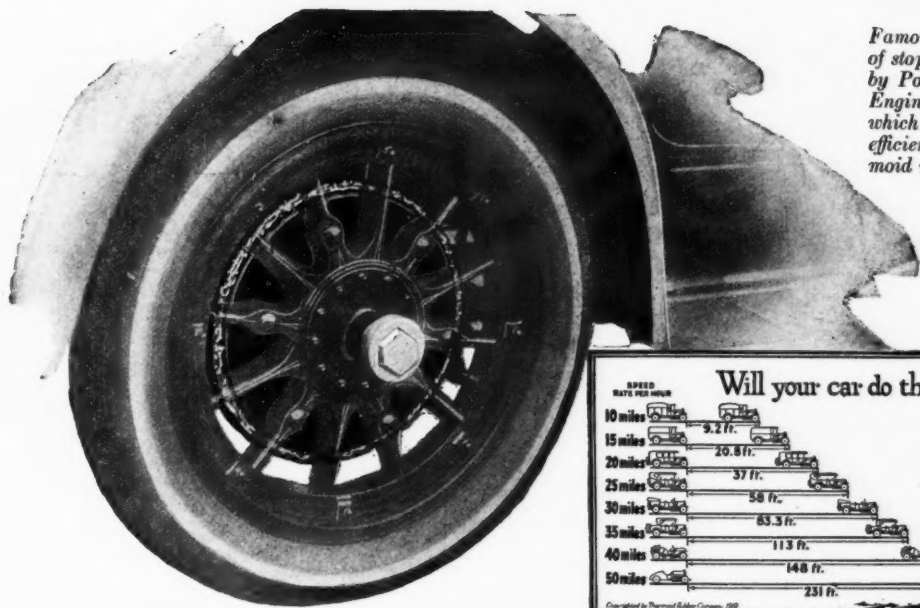
One of the unexpected results of the installation of this conveyor system has been improvement in quality of work. Because the frames enter the priming dipping tank slowly and regularly, priming is more uniform. Greater uniformity in enameling is obtained because the temperature to which the racks are exposed is always the same. Passing through the ovens on a straight line and always at the same level, the frames are kept at a more even temperature than would be possible if they were piled on trays.



MILLER HURST

FOUNDRY CORE DEPT. & CASTING CLEANING LABOR SAVING EQUIPMENT FACTORY OPERATIONS & ASSEMBLIES

THE JAS. F. MILLER & HURST CORPORATION
FOUNDRY & INDUSTRIAL ENGINEERS & CONTRACTORS
GENERAL MOTORS BUILDING, DETROIT.



Famous Thermoid Standard Chart of stopping distances, now approved by Police Officials and Automotive Engineers. Chart shows distance in which car should stop if brakes are efficient. Brakes lined with Thermoid meet these standards.

When a motorist says,

"My brake lining is squeezed out"

this is what he means

Look at the illustration above. See how the lining has been compressed by braking. It has spread out, literally "squeezed out" between the drum and brake band.

Ordinary brake lining is uncompressed till it gets on the brake bands. Naturally it *mashes down*—and makes frequent adjustments necessary.

Thermoid is different. It doesn't "squeeze out" because it is dense, solid. Thermoid contains 40% more material, compressed into it under 2000 pounds of pressure. This means longer life, and freedom from the cost and inconvenience of frequent adjustments.

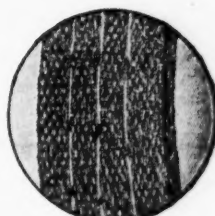
And it means more than that. It means a brake lining that is always *dependable* because it wears down slowly and evenly—and gives constant gripping power until worn wafer-thin.

Amazing tests show resistance to moisture

Recent laboratory experiments show also that Thermoid has astonishing ability to resist moisture. Soaked in water for an hour, ordinary brake lining was found to absorb 164% more water than Thermoid—in boiling oil, 290% more than Thermoid—in gasoline, 194% more than Thermoid.



Left: Steady wear on ordinary soft brake lining soon squeezes out a "ragged edge." This means poor wear and frequent adjustments.



Right: Thermoid Hydraulic Compressed Lining is too compact to squeeze out. Wears down slowly, grips when worn wafer-thin. Needs fewer adjustments.

Standard equipment on 50 leading cars

Because of its unfailing efficiency, its recognized supremacy and longer life, 50 manufacturers of leading cars in America now specify Thermoid Brake Lining as standard equipment.

Send for our booklet, "The Dangers of Faulty Brake Lining." It contains valuable information and complete records of brake lining tests which every engineer will be glad to have on hand.

THERMOID RUBBER COMPANY

Factory and Main Offices: Trenton, N. J.

New York Chicago Los Angeles Detroit Cleveland Atlanta
Kansas City Seattle Boston London Paris Turin
SAN FRANCISCO

Thermoid Brake Lining

Hydraulic Compressed

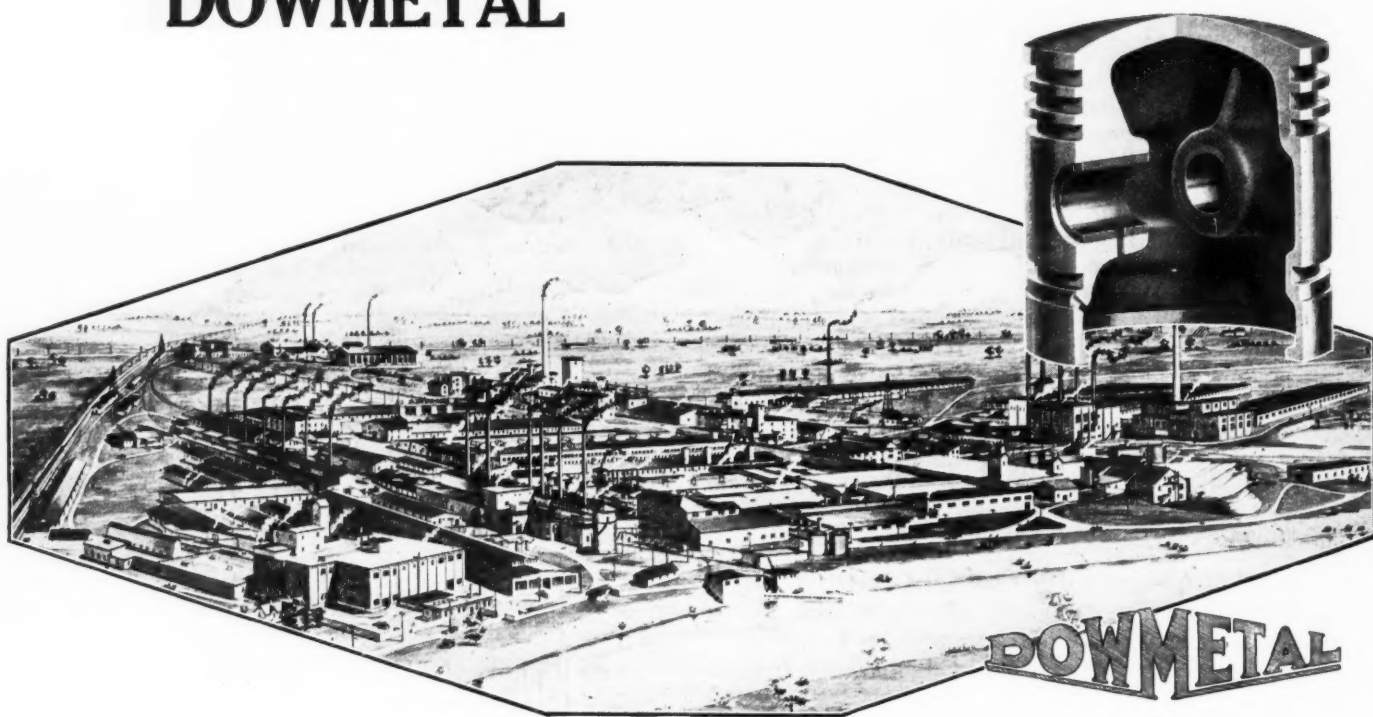
Makers of "Thermoid-Hardy Universal Joints" and "Thermoid Crolide Compound Tires"

LIGHT METAL RESEARCH

A METALLURGICAL DEVELOPMENT

Seven years of experimental research and more than three quarters of a million dollars have been expended in developing the ultimate piston material.

DOWMETAL

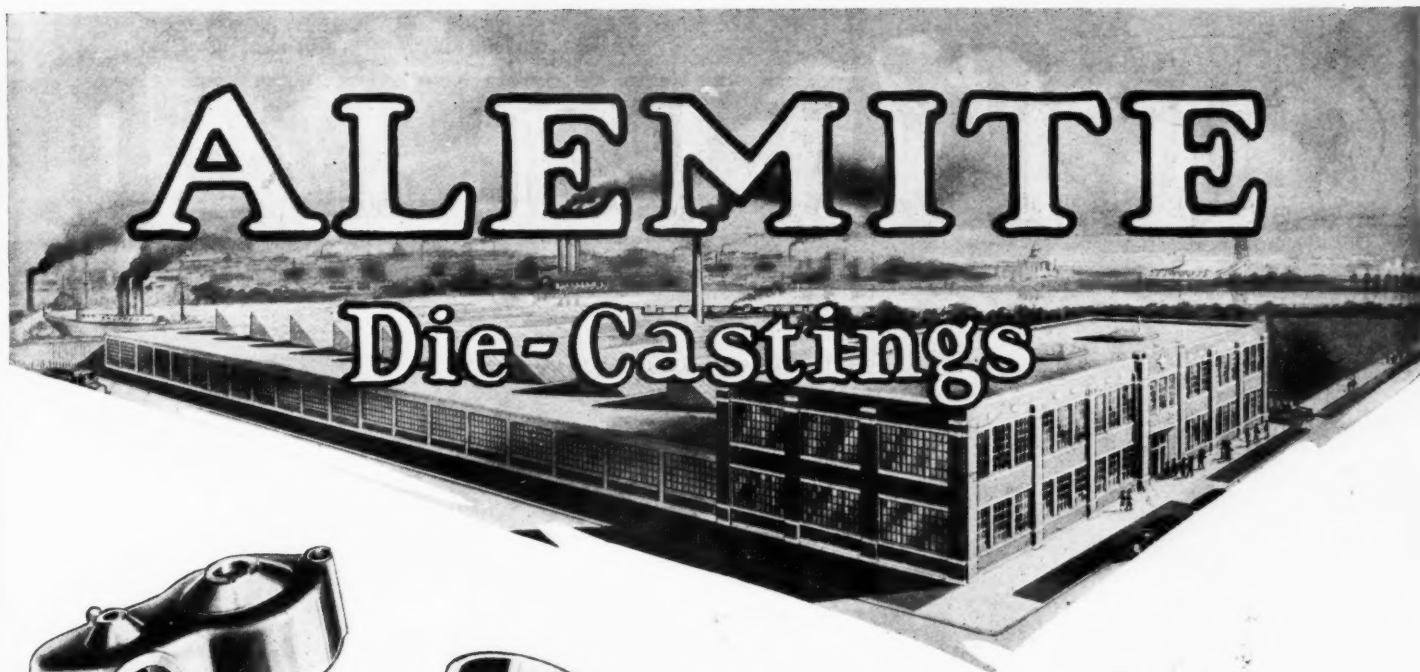


The Plant of The Dow Chemical Company and its tremendous resources are behind DOWMETAL

THE DOW CHEMICAL COMPANY



Midland Mich. U.S.A.



The Process That Insures Extreme Accuracy

Die-castings are not suited to every purpose, but for a great many uses in automotive vehicles and accessories they have proved to be more economical and satisfactory than parts made by any other process. Within certain limitations of size and weight there is practically no design in aluminum, zinc, tin and lead base alloys that cannot be manufactured satisfactorily and economically by the Alemite Process.

Our large modern plant was recently constructed to take care of increased business. The facilities and equipment in this plant are ample for taking care of orders of any size. Prompt deliveries to meet production schedules are assured.

Besides die-casting itself, we have equipped this new plant with plating, enameling and polishing departments, and therefore, we are in a position to turn out parts, completely finished ready for assembling.

Our engineering department is ready at all times to co-operate with manufacturers and engineers. We shall be glad to forward a catalog on request.

The Alemite Die-Casting & Mfg. Co.

2640-2654 Belmont Ave.

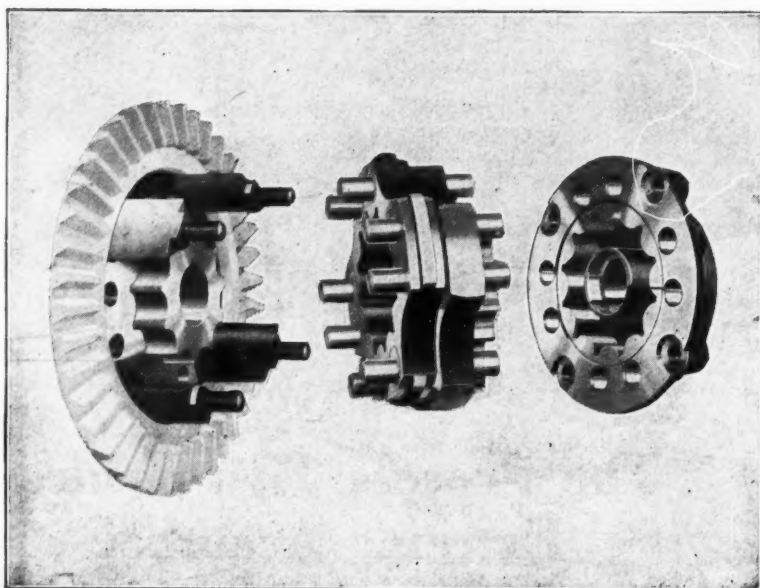
Chicago





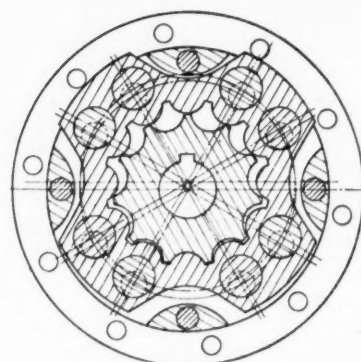
KROHN KOMPENSATOR

THE COMPENSATING DIFFERENTIAL

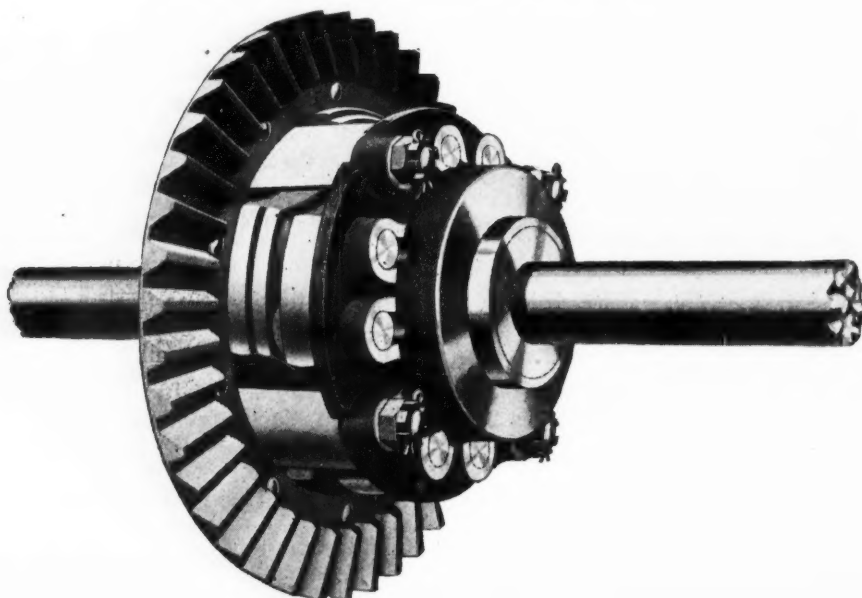
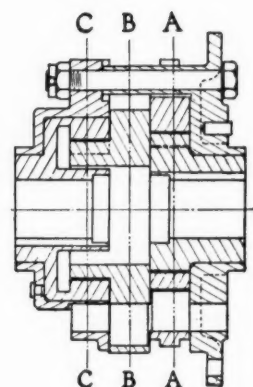


When differential action is induced, the internal gear on one axle shaft section and the external gear on the other axle shaft section turn in opposite directions. The driving plate gear unit swings around the axis of the eccentric rollers. The rollers revolve at a rate much more rapid than the speed of the shaft gears. The ratio is variable and may be 12 to 1 or 16 to 1 or any other ratio as required due to the speeding up action of the two eccentric gear sets.

The rollers are numerous and have large bearing surfaces. The oil film on these surfaces offers effective resistance to speeding up.



SECTION AA



Power from the motor is transmitted through the case where the master gear is located and through double eccentric rollers to two driving plates with holes for journaling the rollers. These plates constitute an external and internal gear set which mesh with mating gears fastened to the two axle drive shaft sections.

KROHN KOMPENSATOR

THE COMPENSATING DIFFERENTIAL



Sends the Power to the Traction

One wheel on solid macadam, the other in slippery clay. What will result when the throttle is opened?

The car with a conventional differential will spin the wheel in the clay. The car with a Krohn Kompensator will surely, steadily pull out. *The power is sent to the traction.*

By employing the adhesive force of lubricant, and the law of frictional resistance, opposition to the flow of power to the free wheel is built higher and higher as engine speed increases. At low speed the resistance is practically nil.

This advantage is gained at no extra expense in the average case. In many cases the Krohn Kompensator costs less than conventional differentials. It requires no special casing, nor is it larger than customary. Its tremendous strength and utter simplicity practically eliminate service.

Various truck and car manufacturers and a number of owners of large fleets have been using Krohn Kompensators for periods upward of two years. You may have their names and verbatim reports of the excellent results they have had.

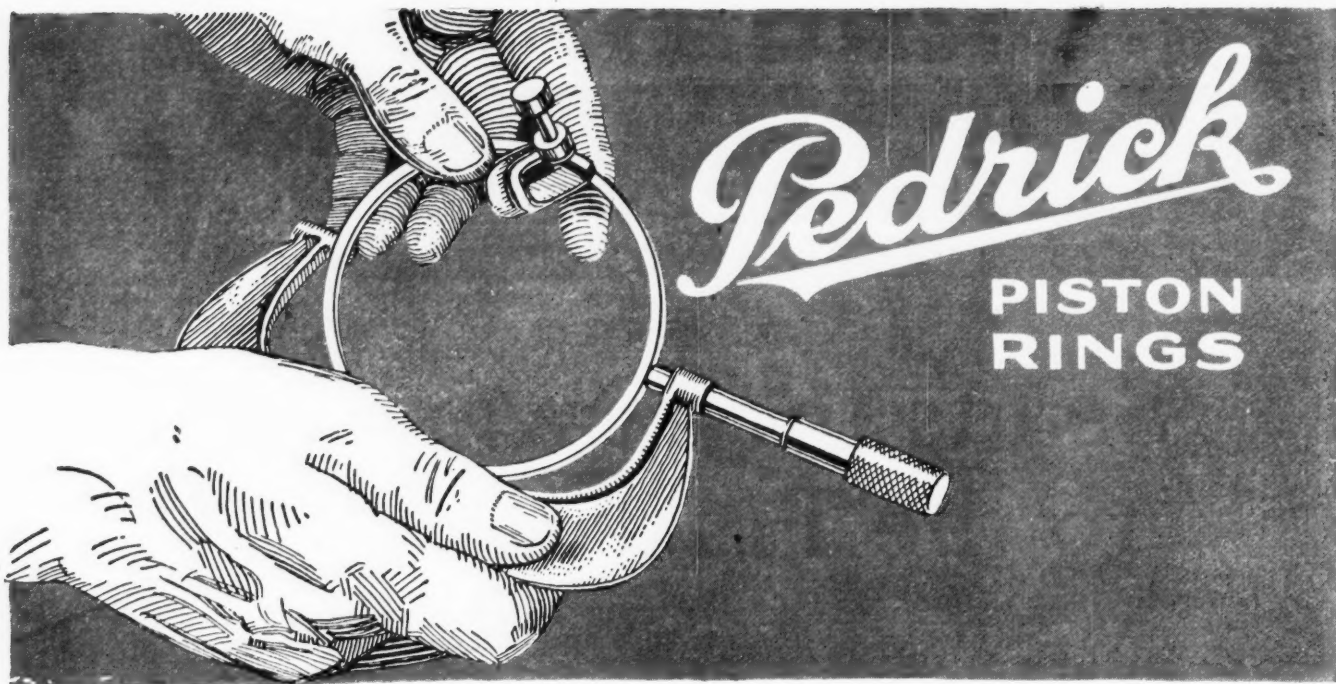
We shall gladly place every facility for thorough tests at your disposal. Request them.

H. McFarlane & Co.

Established 1854

322 South Green St.

Chicago, Ill.



A Precise Application of a Perfect Principle

The Principle

A tensionless circular split ring, expanded by uniform radial outward pressure and set by heat in the expanded position, can be returned to a truly circular shape only by the application of uniform radial inward pressure. Therefore, when a ring expanded and set in this manner is placed in a round cylinder, the pressure between ring and cylinder must be equal at every point of the circumference.

The Application

Rigid comparative tests by leading manufacturers and long service in hundreds of thousands of engines attest that this ideal of piston ring perfection is actually attained by PEDRICK PISTON RINGS in actual production practice.

Refinements The short pot casting which produces iron of lasting tension soft enough to avoid undue wear on cylinders.

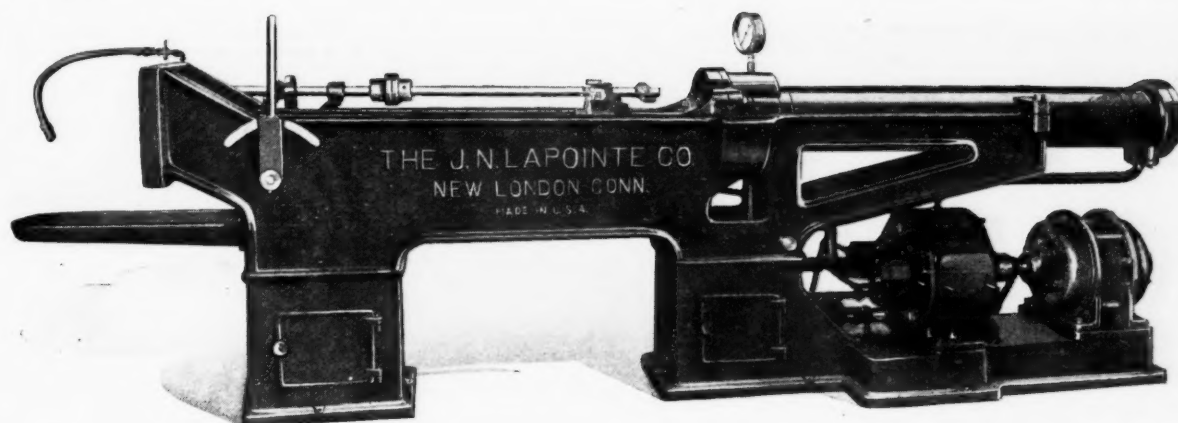
Special facilities for producing narrow rings.

The Oil-Control Ring for optional use in the lowest groove is a complete solution of the oil pumping problem.

Let us prove the theory and demonstrate the precision of its application with sample rings made up to your blue prints.

Pedrick { True-fit
and
Oil-Control }
Heat-Shaped
PATENTED
PISTON RINGS

Made by **WILKENING MFG. CO., Philadelphia, Pa.**



Broaching at 1/3 the Usual Time!

*New Hydraulic Broaching Machine Has
Velvety-Smooth Action Despite Its
Greater Productive Ability!*

THE hydraulically operated Broaching Machine is the latest achievement of the J. N. LaPointe Co. of New London.

With this machine, work is done in $\frac{1}{2}$ to $\frac{1}{3}$ the time usually required.

The hydraulic drive is velvety smooth and the work shows absolutely *no chatter marks!* The drive is compensating and flexible as to speed. The broach always operates at maximum cutting speed and is not, as with the screw type drives, dragged through the work at the same *inflexible* speed.

175 Pieces An Hour!

With a 48 in. broach, 175 pieces were put through this machine in one hour—almost 3 a minute! For an entire job, a saving of 60% in power is made possible.

The high and low limits of rate of feed can be set and locked against interference by operator. A Bourdon gage indicates the force employed in drawing the broach through the work—giving warning as the broach becomes dulled and permitting its useful life to be prolonged.

The type pump used is of long proven efficiency.

Specific details of construction and estimated time figures for any broaching job will gladly be given on request.

This machine has been designed primarily for automotive use. As heretofore, the manufacture of our full line of screw-type machines shall be continued.

J. N. LAPOINTE CO.
NEW LONDON, CONN.
Makers of Broaching Machines and Broaches.

Are you interested in increasing your net revenue?

The foundation of all net revenue in shops that machine metal is the cutting tool.

There are, of course, other factors, such as sales prices and overhead. It can be assumed that in practically all shops these are under control but some manufacturers do not know of the savings in cost and increases in net revenue that can be obtained through the use of Haynes Stellite.

If your company has metal cutting to do you will be interested in the figures on the opposite page.

HAYNES STELLITE COMPANY

Carbide and Carbon Bldg., 30 E. 42nd Street, N. Y.

Peoples Gas Bldg., Chicago

General Motors Bldg., Detroit

4503 Euclid Avenue, Cleveland

HAYNES

INSERTED BLADE MILLING CUTTER OPERATIONS

Part	Operation	Type of Machine	Material	Depth of Cut	Cutting Speed Ft. Per Min.		Feed Per Minute Inches		Pieces Per Grind		Time Floor to Floor		Per Cent Increased Production
					Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	
Cylinder Block	Milling Top Bottom & Side	Six Spindle Line Type	Cast Iron	3-16"	100	60	18	6.0	180	20	1'-52"	5'-10"	176
Cylinder Block	Finish Mill Top Bottom & Sides	8 Spindle Line Type	Cast Iron	1-64"	120	47	7	3.5	250	50	4'-5"	7'-55"	93.7
Flywheel Housing	Milling Joint Surfaces	Double Spdl. Rotary	Cast Iron	5-32"	104	73	10	7.0	100	50	2'-30"	3'-34"	42
Transmission Case	Rough Mill Top & 2 Sides	Single Spdl. Rotary	Cast Iron	3-16"	125	94	12	9.0	500	200	3'-0"	4'-0"	33
Crank Case	Milling Gear End	Plain Horizontal	Cast Iron	3-16"	126	75	9.0	4.5	150	80	2'-0"	3'-34"	78.5
AVERAGE					115	69.8	11.20	6.0					85

BORING OPERATIONS

Part	Operation	Type of Machine	Material	Depth of Cut	Cutting Speed Ft. Per Min.		Feed Per Minute Inches		Pieces Per Grind		Time Floor to Floor		Per Cent Increased Production
					Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	
Cylinder Block	Boring Cylinder	Beaman & Smith	Cast Iron	3-32"	80	50	3 51	2 16	100	50	5'-00"	7'-10"	43 5
Freight Cylinder	Boring	Newton Boring Machine	Cast Iron	3-16"	38	26	2 26	1 56	15	7	20'-40"	26'-30"	28 1
Cylinder Block	Boring Cam, Crank and Generator Holes	Special Foote-Burt Boring Mch.	Cast Iron	3-16"	70	70	2 00	1 30	200	60	1'-48"	2'-18"	27 6
Cylinder Block	Boring Cylinder	Foote-Burt Boring Mch.	Cast Iron	5-32"	94	43	7 65	2 91	200	65	3'-50"	8'-10"	113 0
Junk Rings	Boring	Engine Lathe	Cast Iron	.040"	88	39	2 00	1 00	1629	200	4'-45"	8'-30"	79 0
AVERAGE					74	45.6	3.484	1.786					58

TURNING OPERATIONS

Part	Operation	Type of Machine	Material	Depth of Cut	Cutting Speed Ft. Per Min.		Feed Per Revolution—Inches		Pieces Per Grind		Time Floor to Floor		Per Cent Increased Production
					Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	Haynes Stellite	Other Tools	
Piston	Rgh., Turn Groove & Face	Potter & Johnston	Cast Iron	1-8"	88	60	.040	.040	100	50	2'-45"	3'-35"	30
Armature Shaft	Turn Diameters & Groove	Lodge & Shipley Lthe	Soft Steel	7-32"	170	94	.026	.026	65	40	5'-15"	9'-15"	76
Motor Gear	Rgh. & Finish Turn & Face	Bullard V.T.L.	Cast Iron	1-8"	77	50	.027	.014	110	22	33'-30"	59'-30"	77.7
Beveled Gear	Rgh Web & Finish Flange	J. & L. T. L.	Forged Steel	1-8"	249	128	.040	.040	438	35	1'-45"	2'-30"	42.9
Fly Wheel	Rgh. & Finish Turn one side	Bullard V.T.L.	Cast Iron	3-16"	71	47	.050	.032	48	20	8'-20"	13'-20"	60
				1-32"	110	79	.032	.015					
AVERAGE					120	72	.036	.028					57

Haynes Stellite Tool Cost per piece was less than steel on all the jobs listed above



STELLITE

CUTTING TOOLS



Adaptable to Varying Conditions-Thrusts-Loads

ALL the advantages of the good bearing, plus *adaptability* to varying conditions, thrusts and loads. The 3-area contact design gives to this bearing an *exclusive* feature which is as necessary as it is practical.



Schatz **“UNIVERSAL”** Registered *Annular* U.S. Pat. Off. **BALL BEARING**

THE FEDERAL BEARINGS CO., Inc., Poughkeepsie, N. Y.

Nickel steel

Nickel was the earliest alloying element for strengthening and toughening steel. Alone or in combination with other elements it is, ever increasingly, the most widely used.

For steering knuckles, springs, axle shafts, gears, frames and many other vital parts, automotive manufacturers depend on nickel.

THE INTERNATIONAL NICKEL COMPANY
67 WALL STREET, NEW YORK



WE WILL GLADLY SUPPLY DEFINITE INFORMATION

Vanadium Steel In

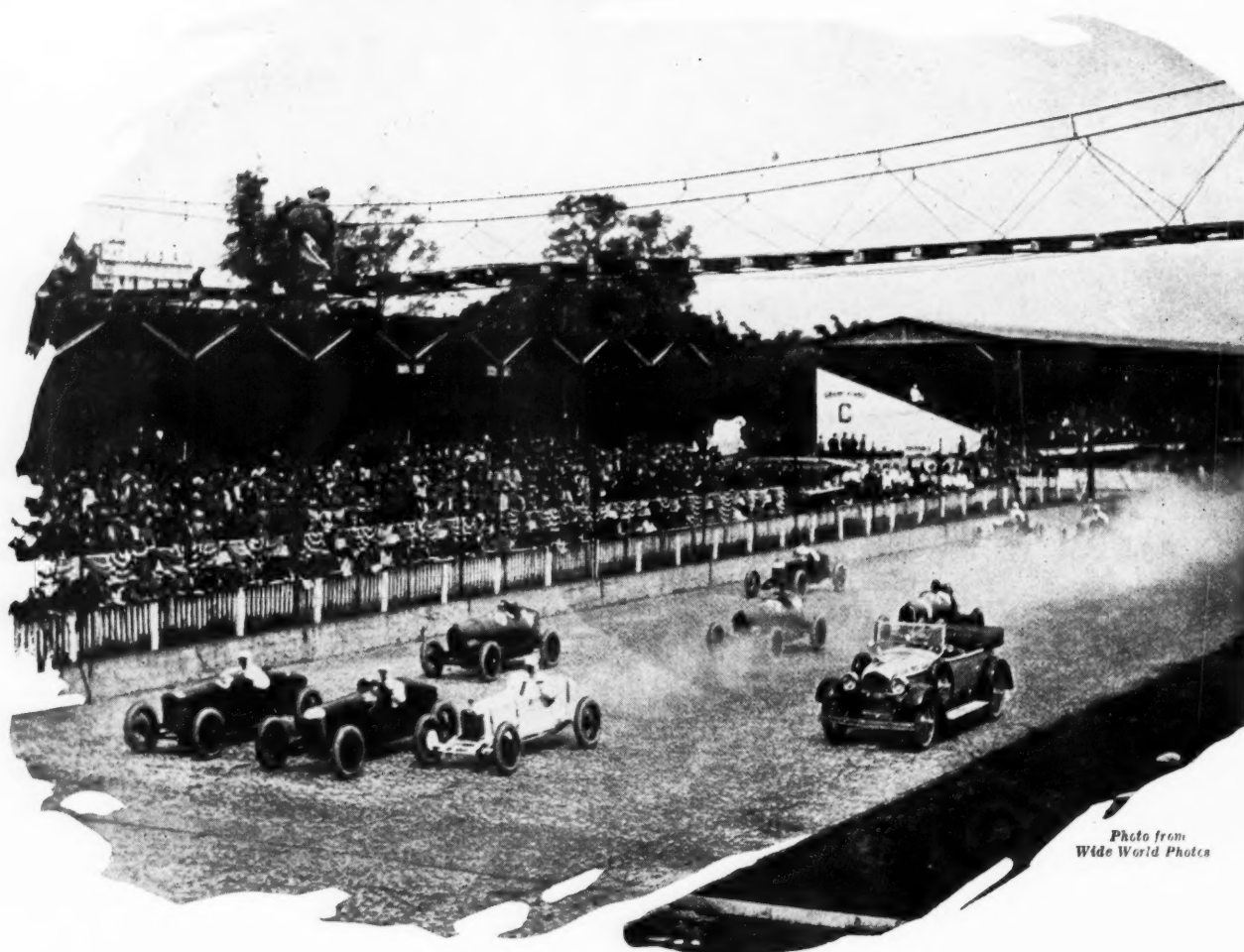


Photo from
Wide World Photos

Flying get-away in the 500 Mile Speed Classic at the Indianapolis Motor Speedway on Decoration Day. Won by Tommy Milton in an H. C. S. Special, equipped with parts of U-LOY Chrome-Vanadium Steel.

VANADIUM

Strength, Toughness

The Winning Cars At Indianapolis

SIX of the first seven cars to finish in the 500 Mile International Race at Indianapolis this year, including the winner, were equipped with

Crankshafts	Springs
Connecting Rods	Propellor Shafts
Axle Drive Shafts	Spindles
Ball Bearings	Steering Knuckles
Ring Gears and Pinions	

of U-LOY Chrome-Vanadium Steel, made by the United Alloy Steel Corporation, Canton, Ohio.

These Miller-motored cars came through the gruelling 500 mile race, and through the thousands of miles driven in preparation for it, without a single failure of a Vanadium Steel part.

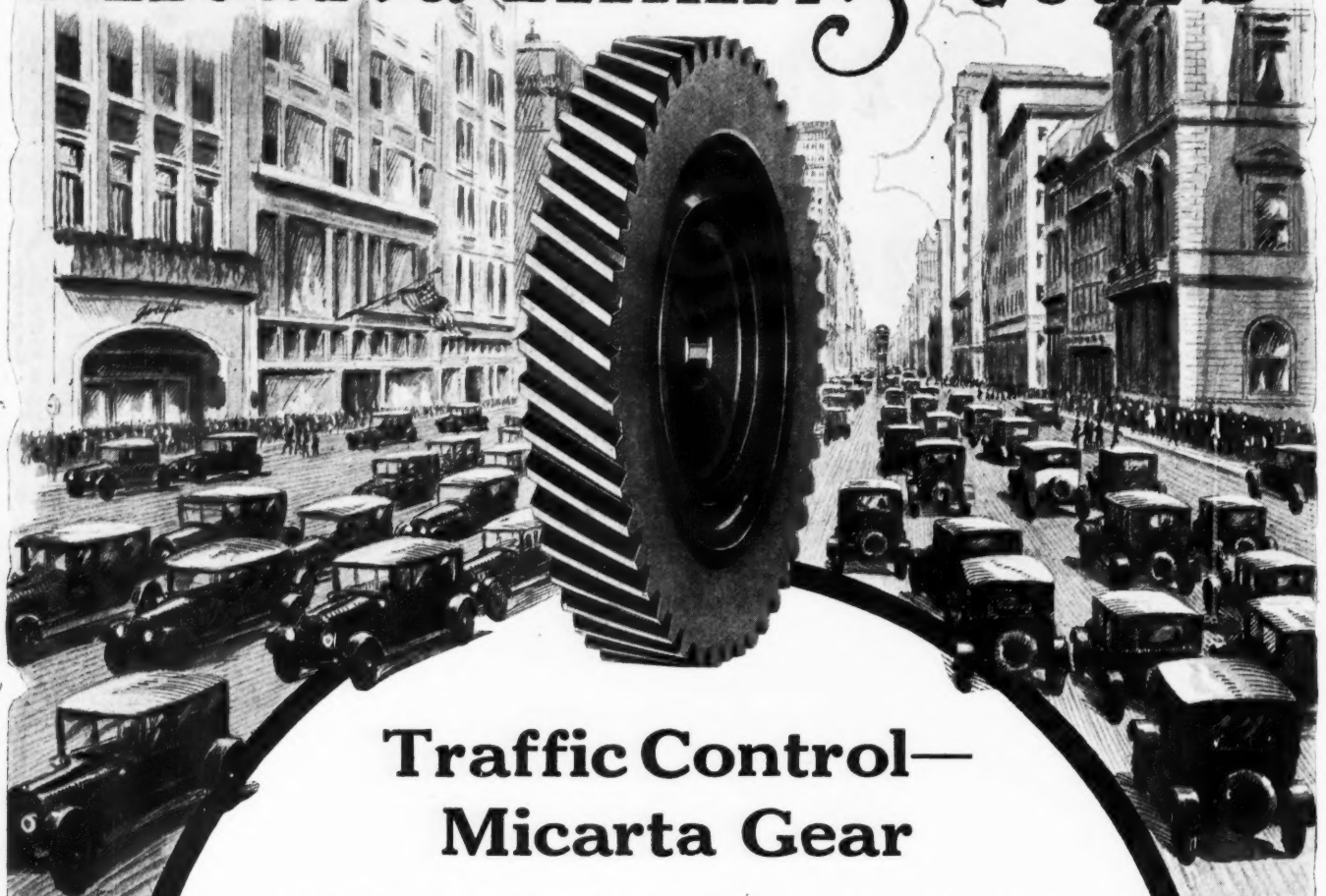
We shall be glad to answer any inquiries regarding Vanadium Steel, its superior strength, toughness and dependability, and its wide application in the vital parts of racing cars, pleasure cars and commercial vehicles.

VANADIUM CORPORATION OF AMERICA

120 Broadway, New York Book Building, Detroit

STEELS *for* *and Durability*

Micarta Timing Gears



Traffic Control— Micarta Gear

The controlling factor at points of congested traffic is the Traffic Station and its operator.

The controlling factor in a quiet "front end" is the NON-METALLIC timing gear.

The controlling factor in the non-metallic gear application is MICARTA.

The controlling factor in non-metallic serviceability and efficiency in the TIMING GEAR train is its location.

The controlling factor in proper non-metallic location, as recom-

mended, is the CAMSHAFT APPLICATION.

Thus, as the main traffic station operates the traffic over the various other crossings *without confusion*,

So, the automotive engine operates the meshing of the many teeth in the timing gear train *without noise*, when the CAMSHAFT GEAR is composed of MICARTA.

Without Traffic Control we have much confusion and many accidents—without MICARTA we have *inefficient engines* and *noisy gears*.

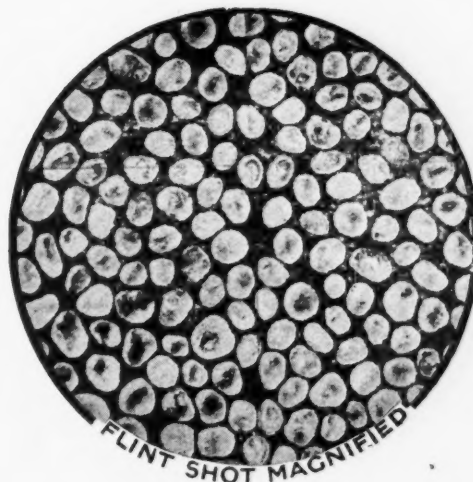
Westinghouse Electric & Manufacturing Company

Automotive Equipment Department

Sales and Service Headquarters: 82 Worthington St., Springfield, Mass.



Westinghouse



The Universal Sand-Blast Abrasive

From electric steel castings, alloy steel forgings or high speed cutters to soft aluminum and brass castings and stampings, testimony is overwhelmingly in favor of Flint Shot.

This apparent inconsistency is explained by the fact that Flint Shot does its work by peening.

The highest air-pressure may be employed on coarse work without splitting the Flint Shot, while for delicate work, or soft metals, very low pressures may be employed.

Flint Shot is uniform in size, free from dust originally, and does not break up under impact. This explains why many makers of sand-blast equipment make it a point to start their machines in each new installation with Flint Shot.

For "Hard" Work

The Falk Company, Milwaukee, Flint Shotted cast steel helical gears weighing 49,000 lbs. each in 6 hours with one man.

The Electric Steel Co. of Chicago use Flint Shot for cleaning all their castings, finding it the only abrasive that will quickly remove the hard burnt sand left by the high pouring temperature of electric steel.

Detroit Twist Drill Co., Detroit, Mich., "Flint Shot" their high-speed tools. Formerly used Silica Sand, but find Flint Shot goes twice as far and gives the work a handsomer, more "silvery" finish.

Warner Gear Co., Muncie, Ind., abandoned wire brush cleaning of alloy steel automotive forgings and now "Flint Shot" everything.

For "Soft" Work

The Detroit Brass Works, Detroit, Mich., abandoned the slow water-roll method of cleaning brass castings in favor of Flint Shotting. Result: increased output; lower cost; more beautiful surface.

Penberthy Injector Co., Detroit, "Find Flint Shotting better and more economical than wire-brushing or water tumbling. Not only reduces costs, but leaves surfaces better for machining."

Zenith Carburetor Co., Detroit, "Flint Shot" aluminum and brass carburetor parts and "like the quick, clean work it does and the fact that it lasts longer and makes less dust."

Save Tool Room Cost

This is more important than many production managers or efficiency experts imagine.

The Ross Gear & Tool Co., Lafayette, Ind., says: "We are sand-blasting everything we can since we discovered Flint Shot. It doubles the life of the wide-forming tools used on inside work and on steel castings. Flint Shotting hot rolled chrome nickel steel bars before putting them in our automatics is of tremendous benefit. We are turning up a ball stud on one machine and before we sanded it we had to grind our tools with great frequency, as the breakdown tools were dulled almost as fast as we could grind them.

"The operator says that sometimes he only turned five balls before he had to grind his tools, and that at other times he might get as high as 200, but that it was very uncertain. Since we have been sanding the bars we are turning 1,500 balls before grinding the tools."

The plant engineer of the Pierce-Arrow Co. at Buffalo, N. Y., said: "Yes, we like Flint Shot, or we wouldn't pay its high price and stiff freight rate. Sand blasting, as you can see, is given a place of great importance with us. Our prime objects are threefold:

"First, to prepare all metal surfaces for enameling.

"Second, to disclose beforehand any defects that may exist in the finished parts treated, so that they may be rejected.

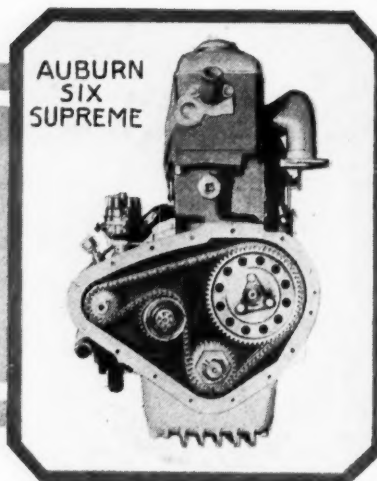
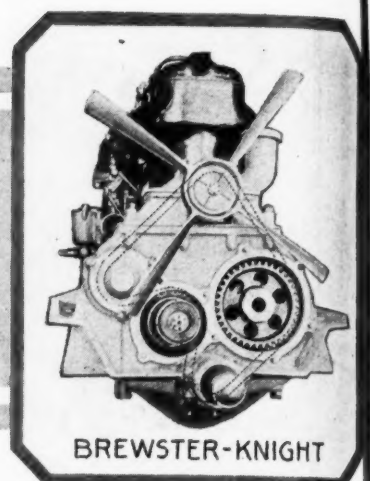
"Third, to save our own tools. This last saving is of greater importance than most manufacturers realize."

Try one carload (or less). The difference will make you a permanent customer.

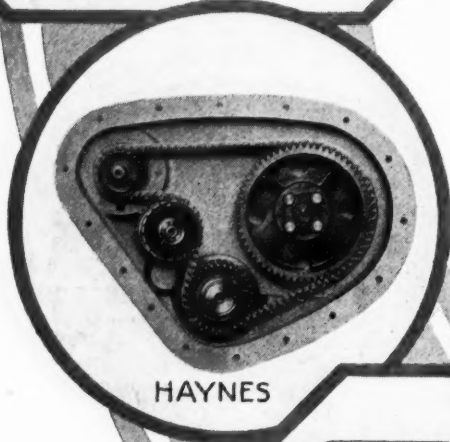
UNITED STATES SILICA CO.
122 South Michigan Ave. Chicago



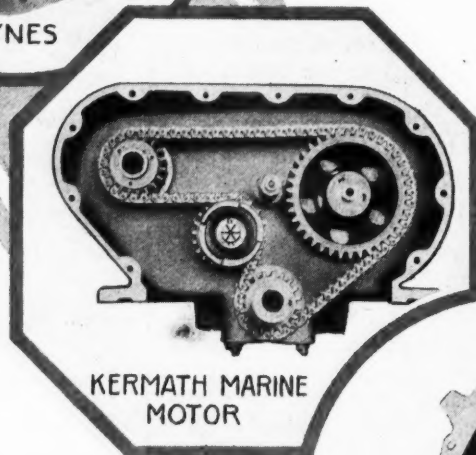
WILLYS-KNIGHT

AUBURN
SIX
SUPREME

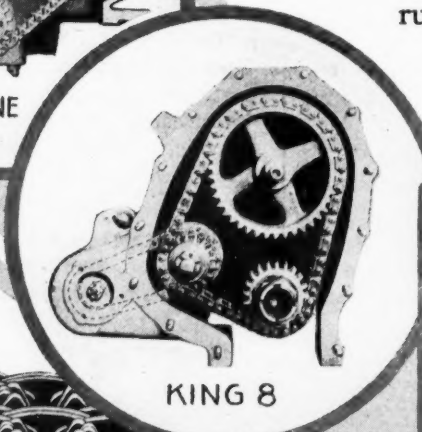
BREWSTER-KNIGHT



HAYNES

KERMATH MARINE
MOTOR

FRONTENAC



KING 8



PAIGE 6-70

QuietMo

Link-Belt Silent Chain "front end" Drives have made possible the continued quiet-running of automobile engines:—

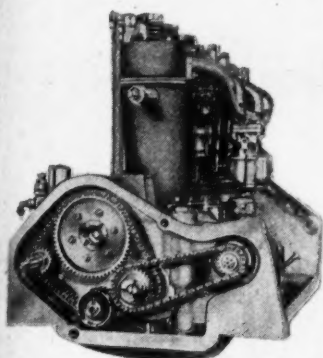
- By eliminating the noisy timing gears.
- Driving the cam, generator and auxiliary shafts with a silent chain—a drive that runs quiet even after long service.
- Furnishing the industry with the most advanced step in "taking up" the chain automatically—the famous Link-Belt Automatic Chain Tightener.

In performance it shows a reliability of operation, true quiet running, and freedom from an

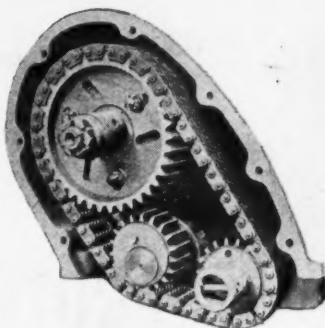
LINK-BELT COMPANY



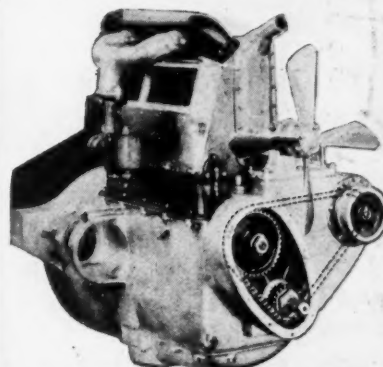
LINK-BELTS



CRANE-SIMPLEX



MERCER 4



ROCHESTER-DUESENBERG

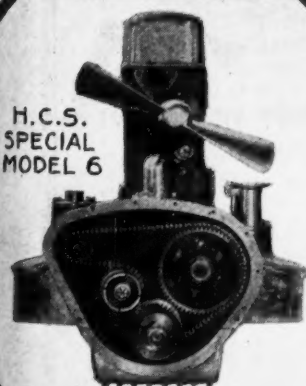
etMotors

having "hand adjustment," that has earned the approval of automotive engineers the country over.

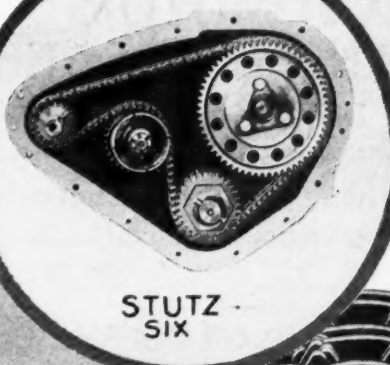
These illustrations show some of our installations. The Ansted, Weidely and Midwest engines and the Roamer, Revere, Meteor and Richelieu cars also use Link-Belt Silent Chain as standard equipment.

If you want the many advantages resulting from the Link-Belt Silent Chain Drive and the famous Automatic Chain Tightener, please write to us. Our experience is at your service.

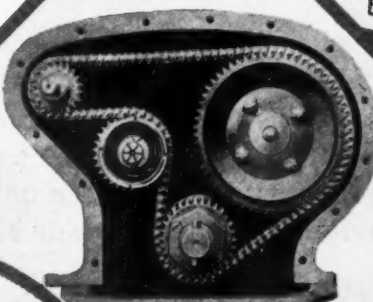
PAN INDIANAPOLIS



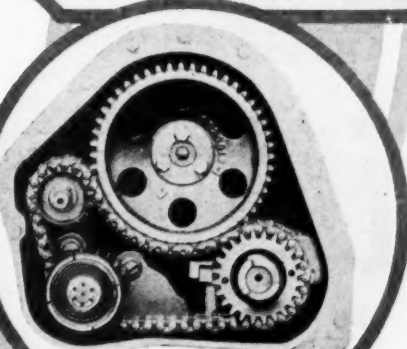
H.C.S.
SPECIAL
MODEL 6



STUTZ
SIX



WISCONSIN
ENGINE



BEAVER
ENGINE



HOLMES

T SILENT CHAIN



"Seeing IS Believing"

THE PROTECTOMOTOR

Not only removes all Road Dust, Sand and Grit from the air supply to the Carburetor and motor, but gives *Visible Proof* that it does it.

More Than 99.9% Efficient under all Conditions

Remove the outer shell from a protectomotor that has been in service and you will observe that the outside is covered with road dust, sand and grit that would cause excessive wear on pistons, rings, cylinder walls, bearings and all other moving parts, while the inside of the filtering medium is perfectly clean and white as when placed in service. Cut out a section and place under a microscope and you will not be able to detect any sand or grit on the inside surface.

THE PROTECTOMOTOR IS MORE THAN AN AIR CLEANER

**Keeps Out All the Dirt. Controls Air
Temperature. Muffles Carburetor Noises**

Made of Aluminum and other Rust Proof Material throughout. Has no moving parts to wear, get out of order and become noisy. Small in size, light in weight, elegant in appearance.

**DOES NOT RESTRICT THE AIR OR DECREASE
HORSEPOWER. REQUIRES NO ATTENTION**

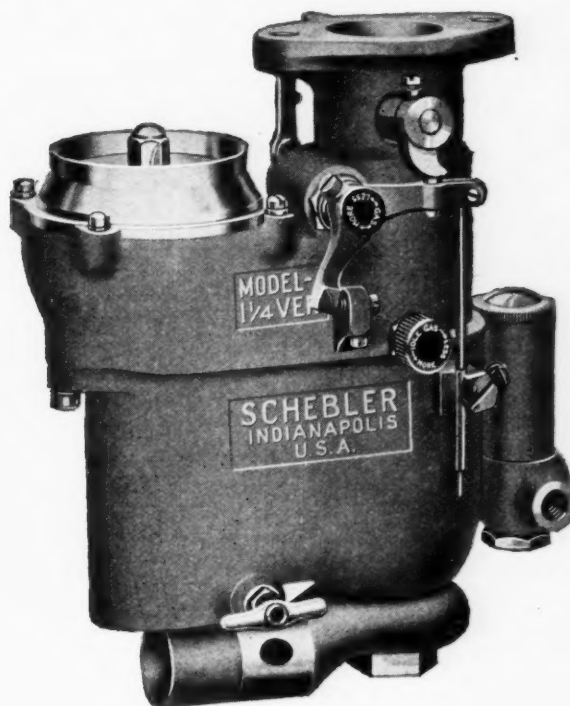
(Complete information on request)

STAYNEW FILTER CORPORATION

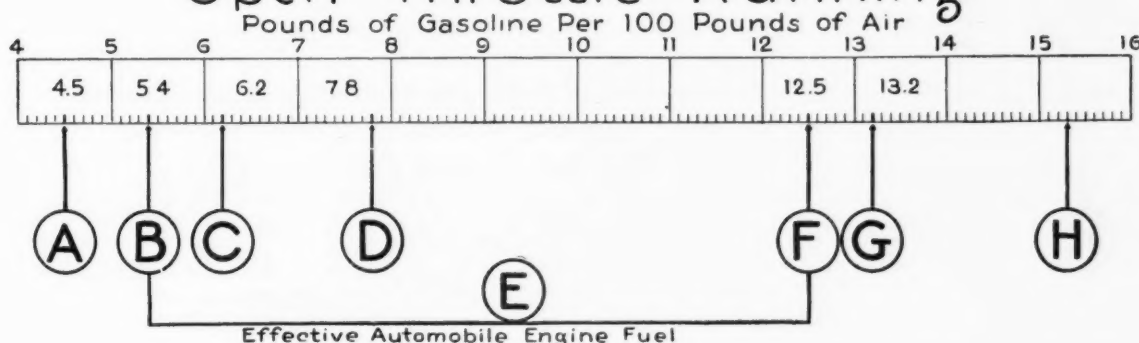
ROCHESTER, N. Y

The NEW Schebler Carburetor "Model S"

The World's Finest Carburetor
Instantly Provides
The Right Mixture in
This Entire Range for
Every Requirement of the Engine



Open Throttle Running



A—4.5 lbs., or less. Non-explosive.

B—5.4 pounds—leanest mixture that will fire without missing in an average engine; too lean for highest miles per gallon, or good power.

C—6.2 pounds—true firing mixture, giving a smooth running engine and the highest miles per gallon, but a little too lean for full power, full hill climbing ability, full acceleration or top speed.

D—7.8 pounds—rich mixture, giving maximum power with a sweet running engine, maximum hill climbing ability, acceleration and top speed, but somewhat too rich for the most miles per gallon.

E—From 5.4 to 12.5 pounds through this range of mixture the engine will run without missing,

give good power and will start easily in moderate weather, running nicely immediately after starting. The power will decrease considerably toward the rich end of this range while the tendency to load will increase, especially when slowing down after a hard pull or when pulling hard at low speeds.

The economy will be poor especially at the rich end and the cylinders will tend to carbon up at the rich end of this range.

F—12.5 pounds—rich end of the mixture that will fire regularly in an average engine.

G—13.2 pounds—will fire but will load badly.

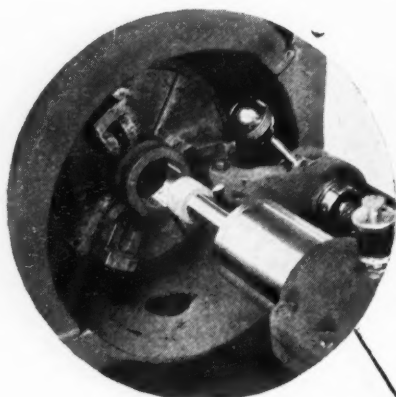
H—above 15 pounds—non-explosive in a hot engine.

Factory tests are now being scheduled and given in the order they are received. We have very interesting data on the performance of the Model "S"—results of tests, charts, and power curves. These will be mailed to engineers on request. Something entirely new on carburetion. Write for it today.

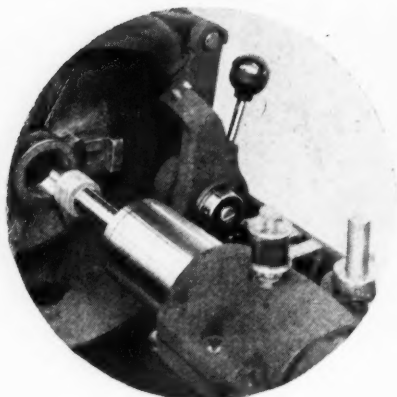
The Wheeler Schebler Carburetor Co.
Indianapolis



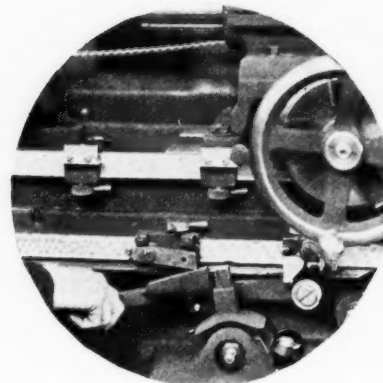
"Bulls Eyes" that Make Your Internal Grinding



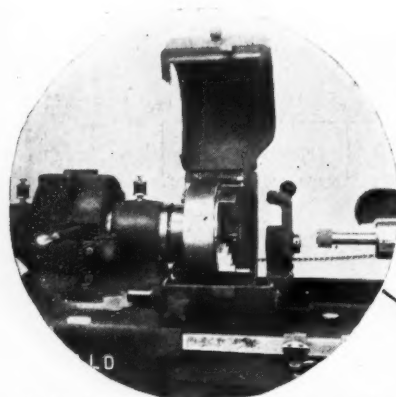
Diamond in position
for truing wheel



Diamond swung back
out of the way

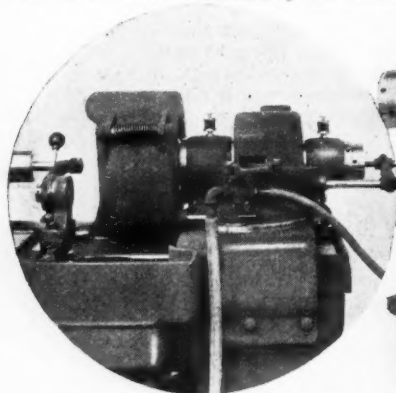


Simply lifting this lever
starts quick traverse

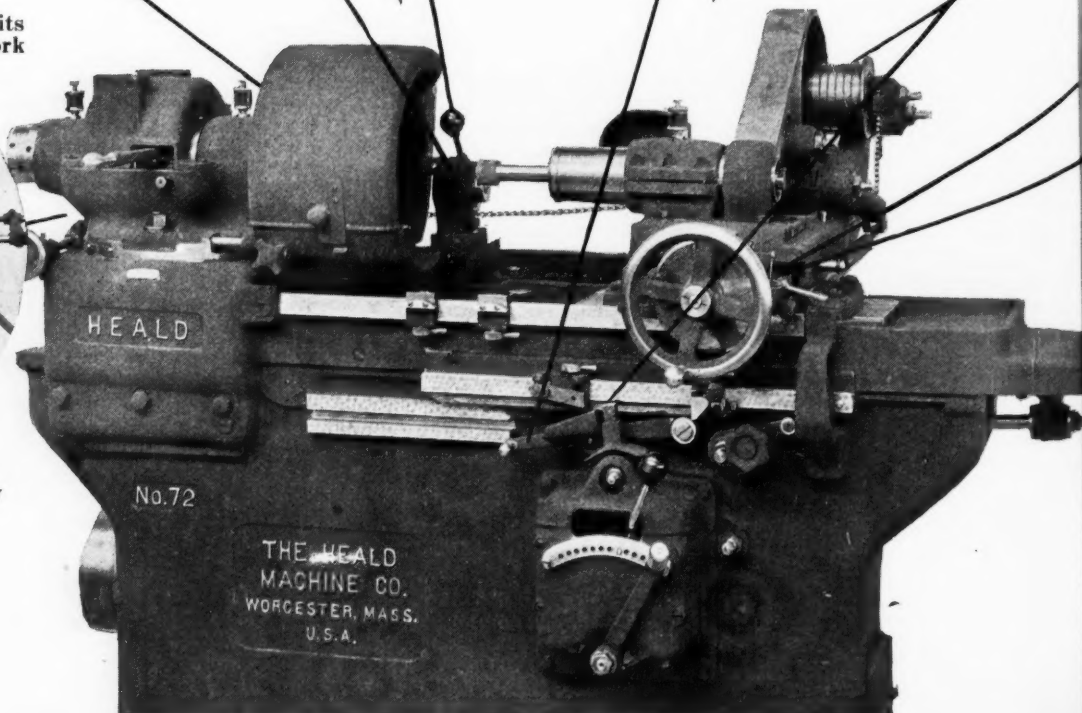


Swinging work guard that permits
operator full accessibility to work

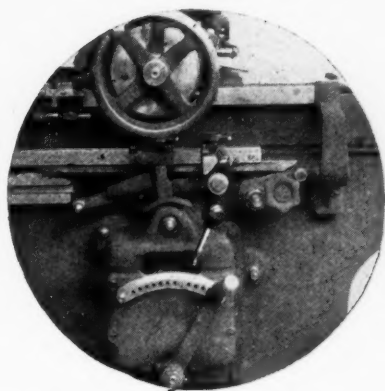
Convenience of Operation means
satisfied workmen who will give
maximum production with minimum
spoilage.



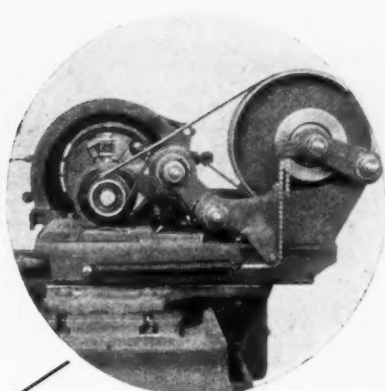
Mechanism that starts and
stops the water simultaneously
with the work



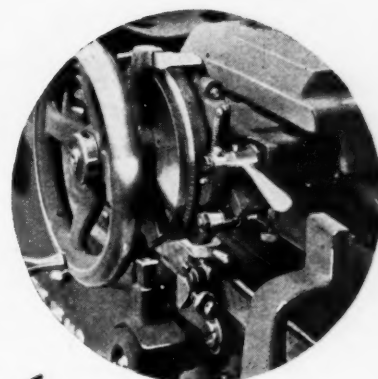
Mean Production on Grinding Jobs



Quick traverse mechanism
at starting position



High Power Idler
Notice beltwrap on wheel head pulley



Hand and automatic
feed pawls for wheel

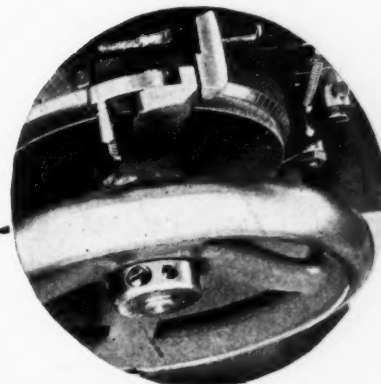
MODERN grinding equipment has reached that state of perfection where operating responsibility is practically nil. Automatic features have eliminated the necessity for "strong-arm" work and simple adjustments, easily predetermined, have superseded guesswork or skill.

All this is especially true with the Heald Internal Production Grinding Machine, Style No. 72, which, with its various automatic and labor saving features as here illustrated, has proven that in keenly competitive tests it will give greater production with less operating and maintenance expense than any other grinder handling similar work.

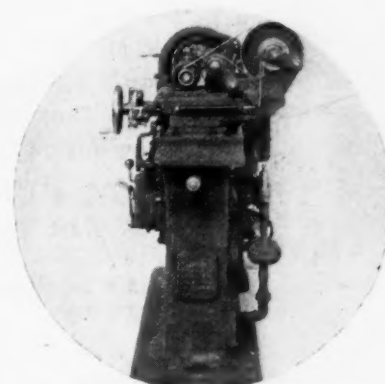
That's broad, but we stand ready to make good in this statement in your factory where we can meet all competitions under your own manufacturing and local conditions.

Look over the "close-ups" of the Heald Improved features, then ask us for proof as to their benefits on your straight and taper hole grinding operations.

We have some interesting facts that will convince you of the superiority of this new machine if you will let us get in touch with you personally or by mail.



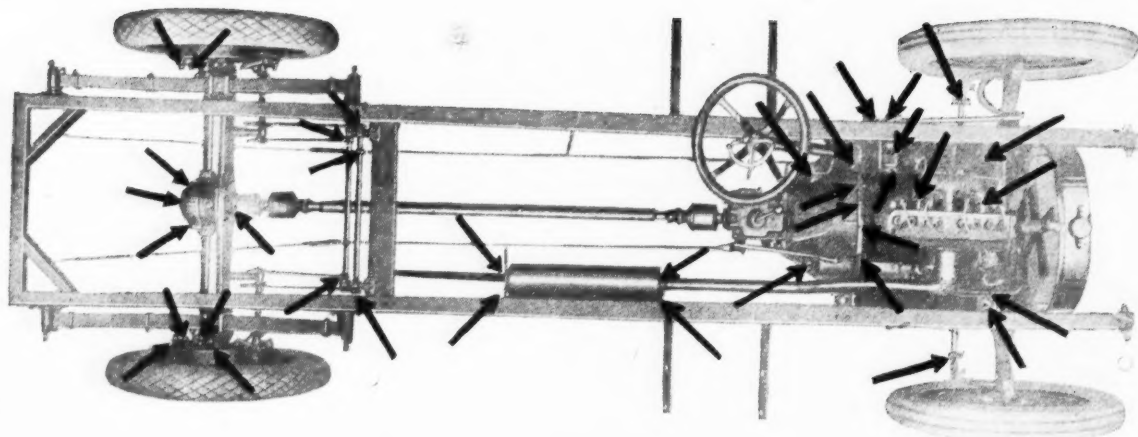
Shows positive stop
for wheel feed



End view

THE HEALD MACHINE COMPANY

11 New Bond St., Worcester, Mass.



A Stronger Assembly through the use of Selflock Cap Screws

TIGHT fitting screw devices that *can't* loosen, except under the wrench, provide greater security and safety. And in the case of Selflock Cap Screws, economy also is effected. The need for lock washers, drilling and wiring is entirely eliminated.

Every Selflock Cap Screw is a self-contained locking device. Although identical with ordinary screws in size, number of threads, etc., their thread base construction is entirely unique.

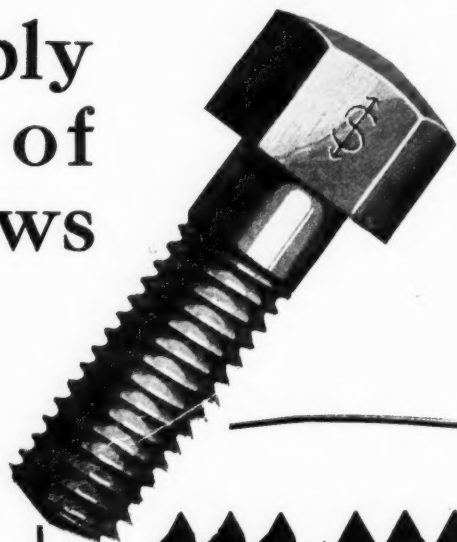
When applied on Standard threads, both threads are deflected slightly and *frictionally interlock*. Only a wrench can budge their vise-like grip.

In your particular chassis, you will find many excellent uses for Selflock Screw devices, on steering gear connections — transmission and clutch assembly — fly wheel — clutch cover — universal joint — clutch spider — timing gear cover — on brackets, fittings, etc., etc.

Write now for complete data.

SELFLOCK NUT & BOLT CO., Inc.
East Syracuse, N. Y.

*Selflock Carriage and Machine Bolts made under license by
Bethlehem Steel Co., Bethlehem, Pa.*



Selflock Thread	U. S. Standard
U. S. Patents No.	Thread
1,250,748, No.	
1,300,801.	

SELFLOCKING Screwthreads are equal in area and strength with Standard threads. They differ only in the shape of their cross sections.

The depths, flats, top and bottom, width of bases, and the number of threads per inch are exactly the same. The only difference is that the bases of the *SELFLOCKING* threads are to one side of a few thousandths of an inch.

Although the contour of each type of thread is slightly changed, the bearing sides of both nut and bolt threads are in perfect contact, and each and every *SELFLOCKING* thread carries its proportion of the total load.

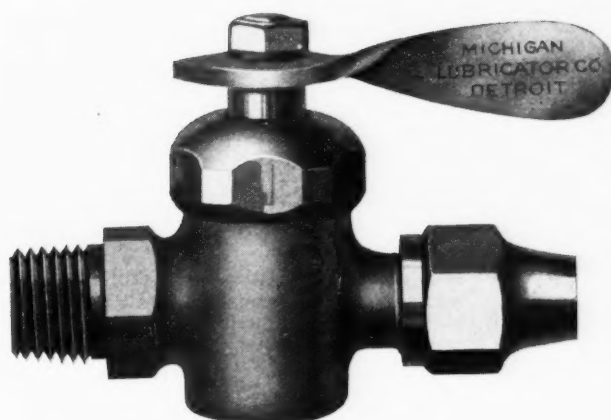
Samples on Request

Automotive Engineers and executives are invited to write for samples of Selflocking screw devices for testing purposes. Specify sizes desired.

SELFLOCK

NUTS - CAP SCREWS - SET SCREWS - STUD BOLTS

KANT-LEAK GASOLINE COCKS



Approved by Underwriters' Laboratories

The Michigan Kant Leak Gasoline Cock is sealed up tight so that it can not leak. The plug is held tight to its seat by a stiff spring and the plug and body are carefully ground to a gasoline tight seat insuring a perfect shut-off.

Notice the list of a few of the more prominent users of our Kant Leak Cock and ask any of them regarding the performance.

The illustration shows one style but we can furnish a great variety of styles.

Standard Equipment on Following:

ESSEX
FORDSON
HAYNES
HUDSON
JEWETT
JORDAN
MOON
PACKARD
PAIGE
REO

And Many Others

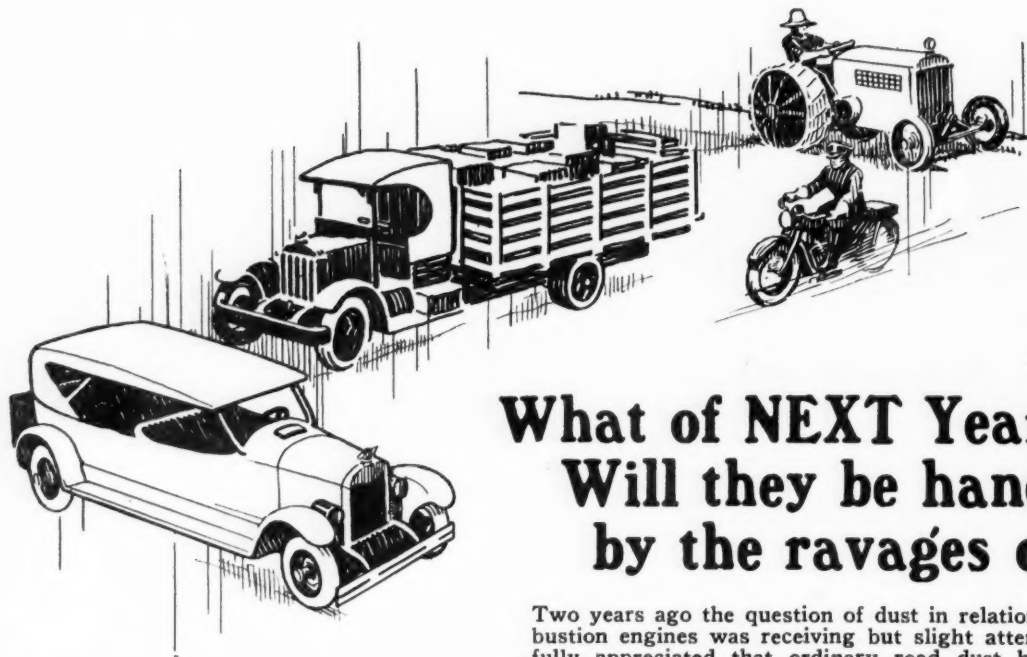
Reo uses a straight way similar to illustration; Paige uses an angle type; Fordson uses a three way for switching from kerosene to gasoline; Hudson uses a three way under the vacuum tank, one throw of lever sending gasoline to carburetor, another throw shutting off carburetor and another throw of handle drains from vacuum tank.

We will gladly furnish any manufacturer with sample, blueprint and any other data we have.

MANUFACTURED BY

MICHIGAN LUBRICATOR CO.

Detroit, Michigan



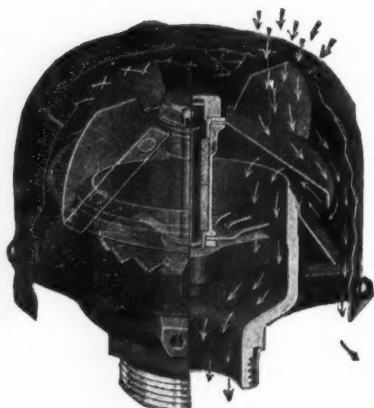
What of NEXT Year's Models? Will they be handicapped by the ravages of dust?

Two years ago the question of dust in relation to internal combustion engines was receiving but slight attention. It was not fully appreciated that ordinary road dust has a considerable abrasive action on cylinder walls, pistons, rings, bearings, valves, etc. And only recently it was proved beyond all doubt that so-called carbon deposits are in reality made up mainly of ordinary road dust.

Today, the question of dust is receiving serious consideration. It is now realized that the manufacturer who sends out a vehicle without making provision for keeping dust out of the engine is placing a definite handicap on the vehicle's performance. Sooner or later the abrasive action of dust will reduce the efficiency of the engine.

Over fifty manufacturers of vehicles and engines have solved the problem of adopting the United Air Cleaner as standard equipment. May we send you complete technical data and detailed information?

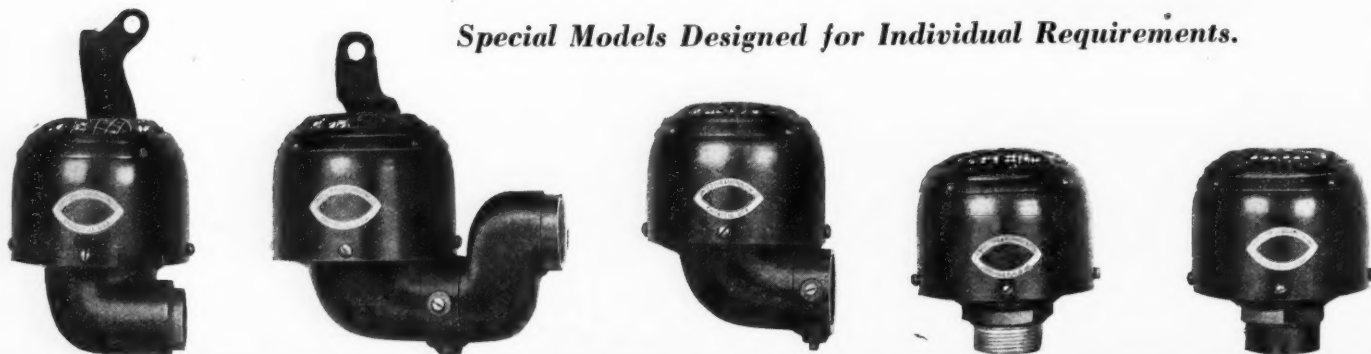
UNITED MFG. & DISTRIBUTING CO.
9705 Cottage Grove Ave., Chicago



Weighs only 18 ounces.
(1" size.)
Does not reduce engine power.
Requires no attention, no emptying, filling, oiling or adjusting whatever.
Is entirely automatic, silent, sturdy and simple (one moving part).
Removes all abrasive matter from indrawn air.
Inexpensive.

The UNITED AIR CLEANER

Special Models Designed for Individual Requirements.



CELOTEX

A New, Light, Silent Roof-Panel

A one-piece, rumble-less roof, of strength equal to slat construction, greatly resistant to heat conduction, at low cost is offered you here.

A one-piece roof means much shorter time in the body-shop. Absence of rumble, combined with stiffness is what you have always wanted. Loaded with forty pounds, a Celotex roof showed less deflection than a slat roof similarly tested.

Let the sun beat on the top as it will. Celotex transmits less than half the heat of white pine, the standard of heat insulation. Passengers under Celotex ride in greater coolness.

The process of moulding Celotex perfected by us is absolutely reliable. And a month's supply for the average automotive factory can be loaded in one freight car. Once in operation, you may put the large majority of your body builders at other work, using far fewer for top construction.

Tear off the inquiry tag, and hand it to your secretary.

Haskelite Mfg. Corp.

133 W. Washington St
Chicago, Ill.



Made of Cane Fibre

When the sap has been pressed from cane, there is left a mass of long, tough, strong woody fibre called bagasse.

By a process resembling both paper making and felting, the bagasse is knit and compressed into a sheet $7/16$ of an inch thick, and unbelievably light. A piece as big as the Saturday Evening Post weighs about a third as much.

Secretary:

Write the below address, requesting Celotex samples for laboratory tests, and costs based on..... tops per month. Address same to

Haskelite Mfg. Corporation
133 W. Washington St., Chicago, Illinois

LINCOLN



*"Snubs
The
Rebound"*

**Standard
Equipment**

ON

Four Wheel Brake



RICKENBACKER

AND

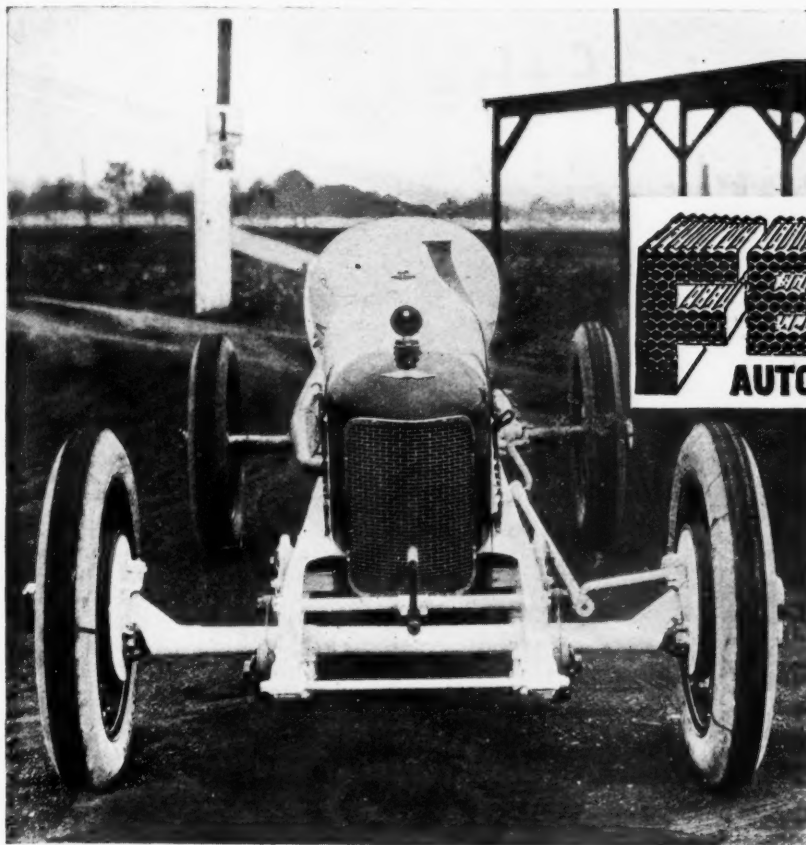
APPERSON SIX



The strength and simplicity of Lincoln construction makes these fast working shock absorbers far more satisfactory, both from the car-owner's and manufacturer's point of view.

LINCOLN PRODUCTS COMPANY
1253 So. Michigan Ave. Chicago, Ill.

SHOCK ABSORBERS



On the winning car at Indianapolis

Fedders have more victories to their credit than all other makes of radiators combined.

4 out of the last 5 winners at Indianapolis were Fedders-equipped

1919—Peugeot—Howard Wilcox
1920—Monroe—Gaston Chevrolet
1921—Frontenac—Tommy Milton
1923—HCS Special—Tommy Milton

500 Miles—5000 R. P. M. —and Cool!

THE performance of the 122-inch motors at the Indianapolis Race was a revelation.

Tommy Milton kept his Miller-built H. C. S. Special turning over at 5000 R. P. M.—2500 explosions per minute in every cylinder.

Imagine the heat generated in there. Think of the cooling problem involved.

But not too great a problem for the Fedders Radiator to which the job was assigned.

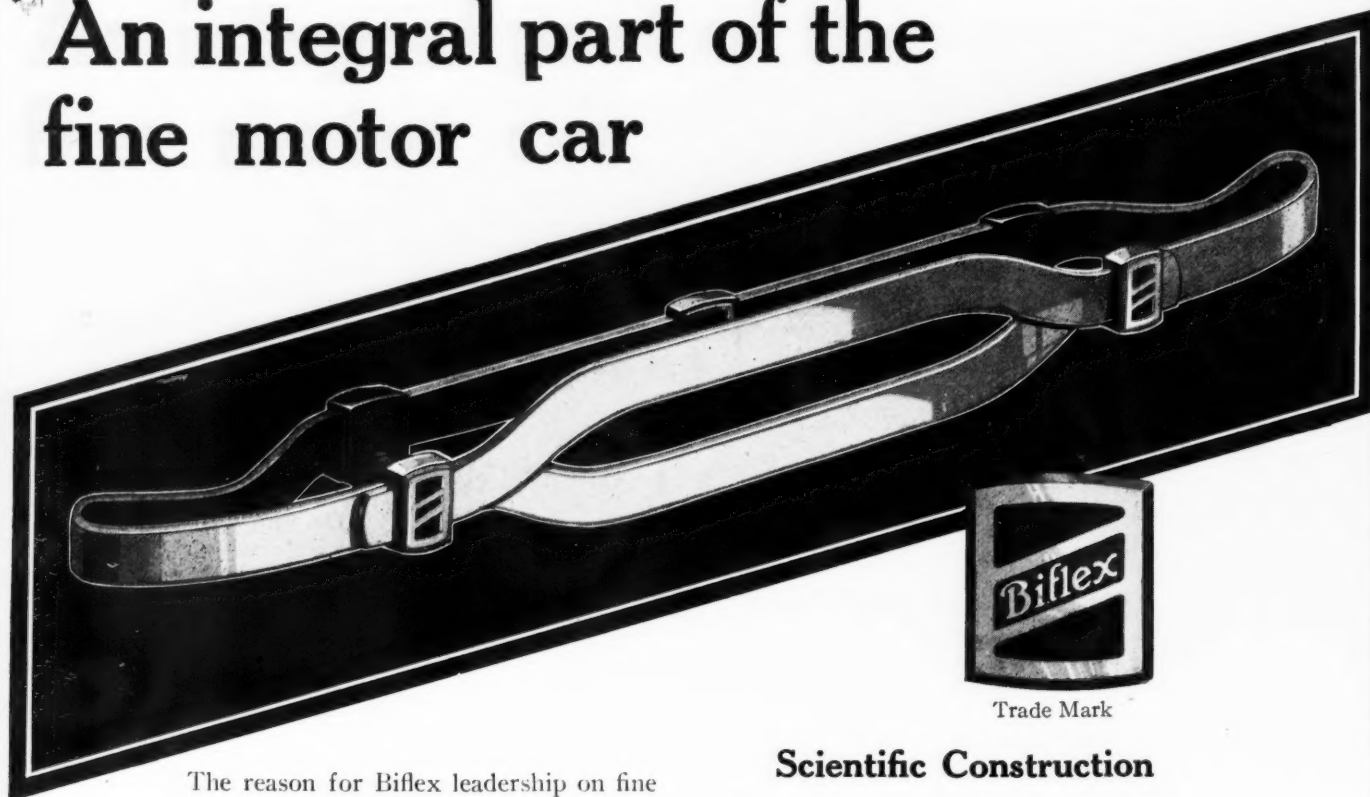
Another Fedders' Performance!

Denver, Colo., June 14, 1923 (Telegram):—
Lloyd Clymer driving Dort stock six equipped with Fedders radiator successfully completed at noon today most serious and gruelling hill climbing contest ever held in this territory. **STOP** With car sealed in high and Fedders radiator cap sealed Clymer made 34 round trips 437 miles over famous winding and steep grades of Look-out Mountain. **STOP** Large percentage all makes cars unable to make grade on high even once and water boils in largest percentage of cars. **STOP** Clymer carried a total of 180 passengers who changed each trip. **STOP** At top of mountain passengers could lay face on radiator, car cooled so perfectly.

JOHN W. SHEARN, JR.

Fedders Manufacturing Co., Inc.
Factory and General Offices Buffalo, N. Y.

An integral part of the fine motor car



Trade Mark

The reason for Biflex leadership on fine cars is close to the surface.

Biflex came out when the bumper business was young. It was built to give real bumper protection, not to compete with other bumpers or to get around other bumper patents.

As the original double bar bumper with *maximum bumping area with minimum overhang weight*, Biflex retains its leadership in the public mind and in the automotive world.

The basic mechanical principles governing the construction of Biflex Bumpers, as well as their harmonious beauty meet all requirements.

The beauty of Biflex Bumpers adds a finishing touch of completeness and unity to the car builder's designs. Makes Biflex an integral part of the fine car—created for it and with it.

Scientific Construction

The trained mechanical mind quickly appreciates why the double bar construction gives maximum cushioning area. Why the full-looped ends furnish flexibility capable of rebounding to terrific shocks. Why the wide buffing surface blocks bumpers of all heights and takes blows from any direction; why the hoop-like construction is necessary to afford 100% bumper protection.

Other types may have one or more of these advantages, but in no other will be found a combination of all of them.

So it is no wonder Biflex Bumpers quickly rose out of the accessory class into necessities for the fine car.

Knowing that a bumper could be no stronger than its brackets, the makers of Biflex Bumpers solved this problem along with that of the bumper. Biflex Bumpers and Brackets are guaranteed for one year and fully protected by U. S. Patents.

The BIFLEX CORPORATION
Waukegan, Ill.

Biflex

Spring Bumper

PROTECTION with DISTINCTION

—STRIP STEEL—

HOT ROLLED
COLD ROLLED

—SHEETS—

AUTO-BODY
FULL FINISHED
FURNITURE STOCK
BLACK
BLUE ANNEALED

—PLATES—

FIREBOX
STILLBOTTOM
FLANGE
TANK

—STEEL CASTINGS—

1 TO 150,000 POUNDS

—PIG IRON—

— . . —

THE OTIS STEEL COMPANY
CLEVELAND, OHIO



CHROME NICKEL STEEL and Nothing Else

When the S. A. E. recommends a certain metal for a certain purpose, it is useless to seek a better. All the possibilities have been canvassed.

They have recommended S. A. E. 3120 Chrome Nickel Steel for piston pins. Their recommendation is being followed by an increasing number of leading automotive manufacturers.

Without exception we make our piston pins of that metal. By this simple rule we eliminate every chance of inferiority, as our workmanship is in keeping with material.

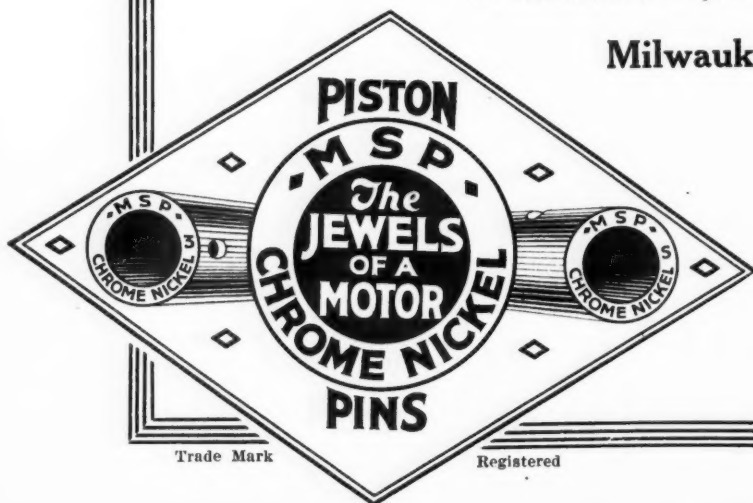
Every pin is stamped on the end with the initials M. S. P. between small diamonds; our registered trademark. There could be pins as good without that mark—but we know of none, at least in the open market.

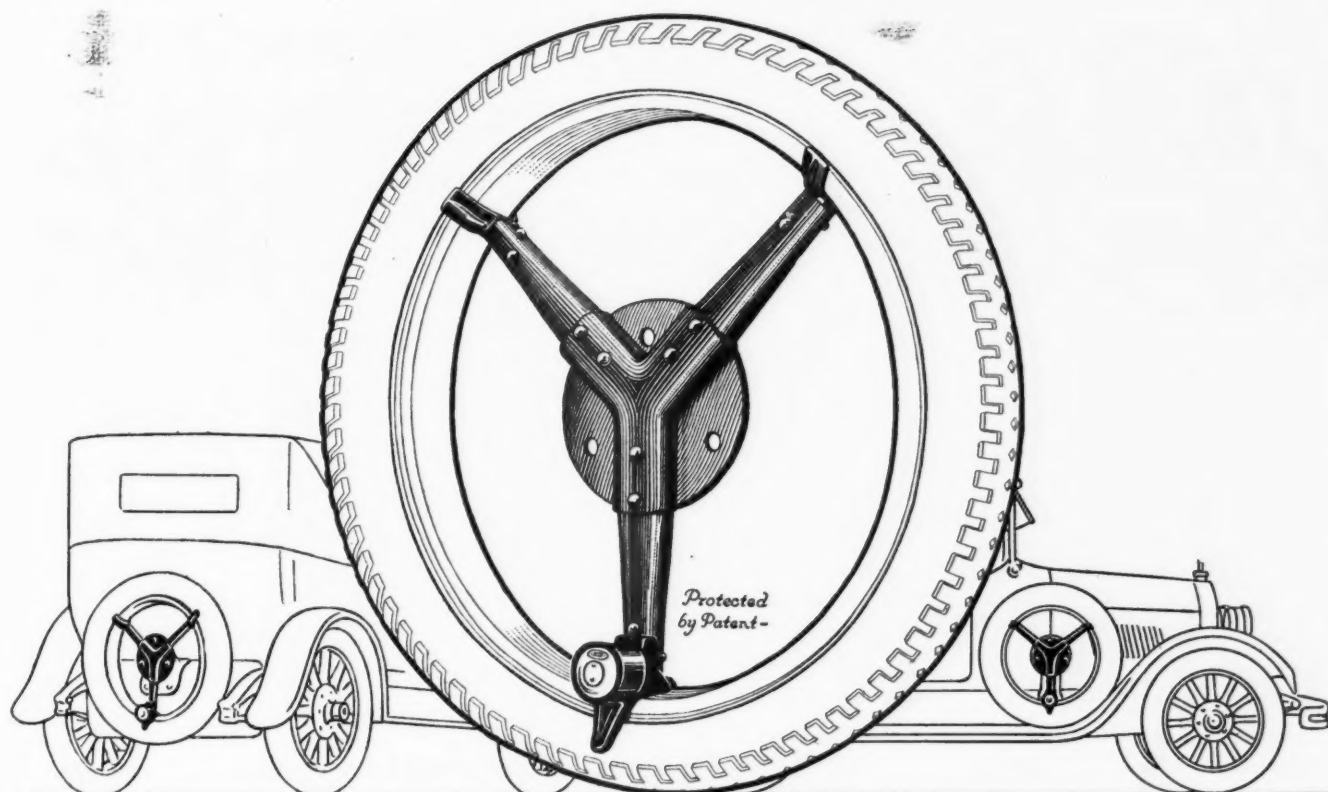
Though 3120 costs us double the price of carbon steel, our prices are not excessive. Thus you may raise your car into a higher quality-class by using our pins, without bringing it into a higher price-class. Make a note of that, and ask for quotations when specifying for all future models. Many leading manufacturers are doing so.

We manufacture piston pins only.

Milwaukee Screw Products Co.

Milwaukee, Wisconsin





Oakes Spare Tire Carrier

THE marked distinction and individuality of the Oakes Tire Carrier make it an important asset to the many high-grade cars now using it as a standard equipment. Mounted on the side, it adds a touch of smartness to a roadster or sport model. Installed on the rear, it completes the graceful lines of a touring or closed car.

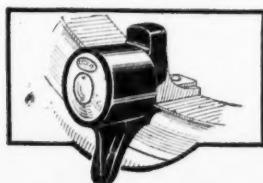
Substantially made of pressed steel, it is light, strong, rigid, rattle-proof and very durable. Easily installed on the car by means of a standard bracket, which may also be used for mounting a dummy hub for a spare wire or disc wheel. It is the only tire carrier having this important feature.

This carrier may be equipped with the Oakes Spare Tire Lock—a distinctive, dependable device that is standard equipment on 15 makes of cars. It locks the tire securely to the carrier, does not rattle, chafe the tire, nor interfere with the cover.

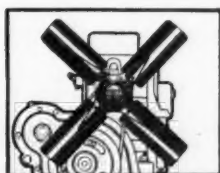
The Oakes Carrier is built in single and double styles. Let us show you how it will save you money and improve the appearance of your car.

The OAKES COMPANY, Indianapolis, U.S.A.

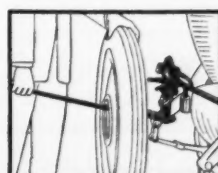
Makers of Metal Products for  Motor Vehicles Since 1910



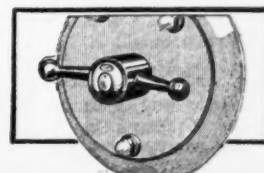
Spare Tire Locks



Radiator Fans



Self-Mounting Carriers



Spare Wheel Locks



ATWATER KENT



"Ability to stand up and keep going

under both favorable and unfavorable conditions" is the reputation equally of the Hupmobile and the Condensite molded insulation of its ignition system.

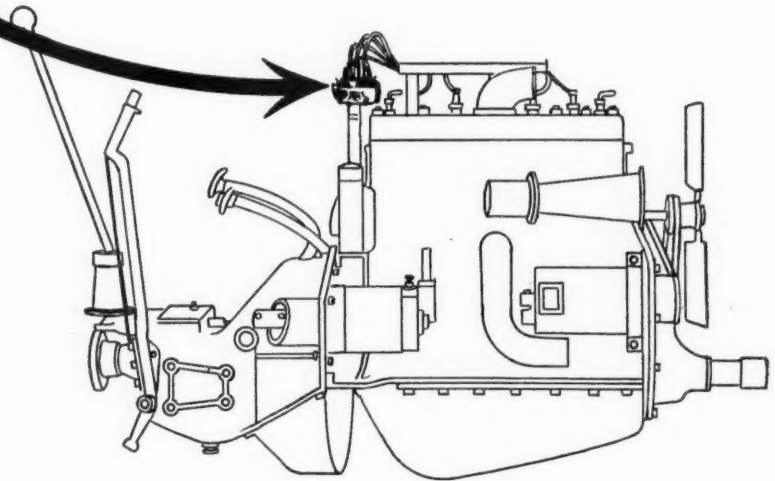
No extremes of heat or cold; no contact with oil or moisture; no vibratory shocks of rough service will affect in the slightest degree the insulating properties of Condensite. These are permanent and do not diminish with age or use.

It is this dependability which has made molded phenol resin—trade-marked Bakelite, Condensite, Redmanol—the standard insulation for automotive ignition systems.

Our research laboratories are equipped to assist manufacturers in developing other automotive applications.

BAKELITE CORPORATION

Address the Divisions



Divisions of BAKELITE CORPORATION

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General Bakelite Co.
8 West 40th St. New York

Condensite

Condensite Co. of America
Bloomfield, N. J.

REDMANOL

Redmanol Chemical
Products Co.
636-678 West 22nd St.
Chicago, Ill.

The Material of a Thousand Uses



Boiling Radiators

*In traffic jams and at low speeds
—COOLING is the problem*

EXHAUSTIVE tests and experiments in our own plant—actual service tests and use in the truck, tractor, aeroplane and fire-service field, have enabled us to meet the great question of cooling with the most efficiently constructed radiator now in use.

In the extreme heat of summer or in the coldest weather—Bush Radiators stand up under the hardest kind of service.

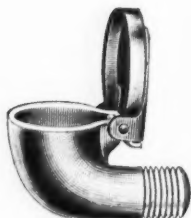
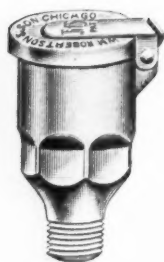
The Bush catalog, giving complete history of this distinctive radiator, will be sent upon request. Send for it today.

BUSH MANUFACTURING CO.,
HARTFORD, CONN.



BUSH RADIATORS

BUILT TO ENDURE



**Jointless Jiffy Oil
Cups**



Standard Grease Cups



**Self-Aligning
Grease Cups**



Dependable Lubrication

An angle oil cup that cannot come apart where the nipple joins the body! It is made in one piece, a seamless drawing, formed by a process exclusive with Wm. Robertson & Son.

This seamless elbow-cup ends the troubles of the motorist who finds a bearing gone dry through the body of the cup coming loose from the nipple. And it simplifies the problem of the engineer seeking dependable oil-lubrication in places where a straight-stem oil-cup will not go.

The tops of these cups can be tilted back by the spout of the oil can which fills them. They will stay in place, showing how much oil has been used; how much is needed. They snap back at another touch of the spout. The spring is under no tension when the lid is closed. Therefore it cannot crystallize and break. It is a flat spring, with only 1/16" play, and no rough points to scratch hands.

Are made in a full line of sizes, as well for use on cars as on machine tools, motors, steam and gas engines. Sufficient pressure can be exerted with the bare hand in screwing down these cups, without forcing the grease through the threads. Their knurled flange is wider and more deeply cut than usual, giving a steady grip, even when coated with grease. We can quote exceedingly low prices on this complete line, without cutting into quality, because our plant is most economically managed, and efficiently arranged.

There is no better grease cup to be had at any price than this. The threads cannot be crossed and stripped, as the post in the center assures alignment the instant the threads are engaged.

Springs pressing against the square center post hold the cup in position with enough tension to prevent turning from the car's vibration, yet not enough to make it difficult to turn them down. Further assistance is given by the broad, easy wing at the top, which exactly fits thumb and forefinger.

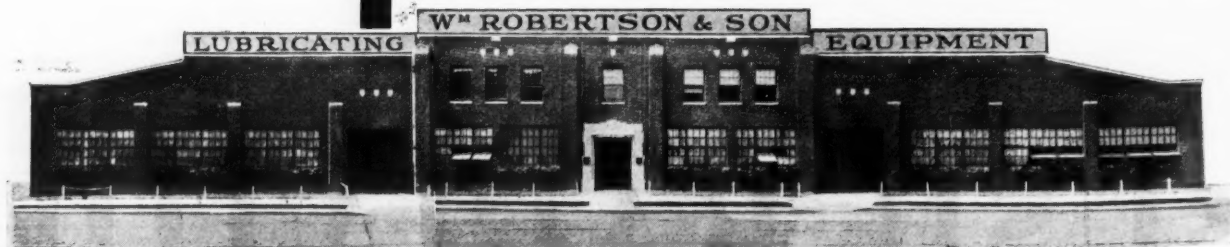
These self-aligning cups are finished in both brass and bright nickel, to harmonize with the remainder of any car's trim. They are made in full range of sizes for every lubricating purpose.

You cannot afford to specify the means of lubrication on next year's models without first investigating the dependability of the Wm. Robertson & Son line. It offers you everything your most exacting ideas require. Ask for a quotation on your first quarter's production.

Wm. Robertson & Son

2012-28 Larrabee St.

Chicago, Ill.



Wm. Robertson & Son's line of dependable lubrication needs is made in this new, light, airy, scientifically arranged building. A man has every chance to do his best here, and the result is shown in big production and low unit price.

R.I.V. is the Symbol of Ball-Bearing Quality

The mind of the engineer turns naturally toward the creation of quality which proves itself in efficiency of operation.

His thought pursues the ideal of perfection—his effort strains always toward its attainment.

Among his most effective aids he finds R.I.V. Ball Bearings—the international standard in friction-eliminating devices.

Made in Italy by artisans in whom accuracy is ingrained by the habit of generations, and to whom precision is the first essential of production, R.I.V. Ball Bearings are now being imported in sufficient quantity to assure an uninterrupted supply and prompt delivery to every factory which utilizes only the highest quality.



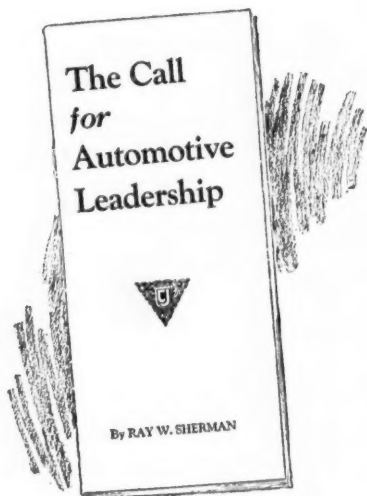
1755 Broadway,

New York City

"Within the next few years millions of dollars will be made from the Automotive Market and most of this profit will be made by a comparatively few companies ~"

So says Ray W. Sherman in his latest booklet "The Call for Automotive Leadership"—just out.

No man today is better qualified to discuss the problems of automotive merchandising than Sherman.



This booklet is crammed full of definite first-hand information on the manufacturer, jobber, dealer situation and looks into the future with a clear vision.

Every automotive Manufacturer should read it as well as every one who has to do with automotive merchandising.

Free—Write for your copy today

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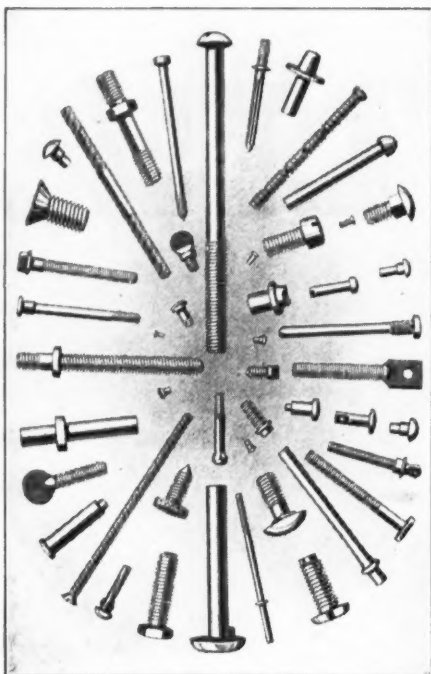
GATES BELTS

"The Standardized Fan Belt"

A test by you will show that Gates Vulco Cord Belts have greater gripping power—less slippage—and the reason is the patented *bias weave* construction.

Made by the World's Largest
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MACHINE and SPECIAL SCREWS HEXAGON and SQUARE NUTS RIVETS STUDS and SPECIALS as ILLUSTRATED



A desirable source of supply with intelligent service is a valuable asset to any manufacturer.

In the planning for your requirements, the three most fundamental considerations are, first, the source of supply; second, the service to be rendered; third, the quality of the product offered.

Specializing as we have for many years in the production of interchangeable parts for the manufacturing trade exclusively, we offer a service that is unique and a product that satisfies.

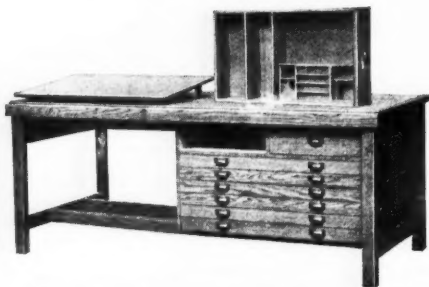
Manufacturers learn to admire business concerns for what they are and what they do, we offer service, quality and price. Permit us to serve you.

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Systematize Your Drafting Room



Standard Blue Print file.



No. 6 type drawing tables and filing cabinet combined.

An Installation of



Equipment Insures the MOST SATISFACTION, the BEST SERVICE, and the GREATEST EFFICIENCY possible to secure in any equipment.

Your dealer can supply your needs, and INSIST on ECONOMY EQUIPMENT; take no substitute. ECONOMY equipment has special features and advantages contained in no other equipment. LOOK FOR THE TRADEMARK.

Economy Drawing Table & Mfg. Co.
Adrian, Michigan

HOW ABOUT CHASSIS LUBRICATION?

**It Takes Owners' Money and Repairmen's
Time. They Both Want to Conserve.
Do so with the**

S A A L OIL SHOOTER

The largest privately owned truck fleet in the world is equipped with Saal Oil Shooters exclusively. The owner, the Standard Oil Co. of Indiana, reports complete satisfaction.

H. G. Saal Company,
Chicago, Ill.

June 15, 1922.

Gentlemen: Replying to your letter of June 13, our experimental department reports that the oil shooters referred to are the best instrument for the purpose that they have ever seen or used.

Very truly yours,

The General Motors Research
Corp.

H. G. SAAL CO.

1800 Montrose Avenue

CHICAGO

ILLINOIS

Know the hardwoods you buy But How?

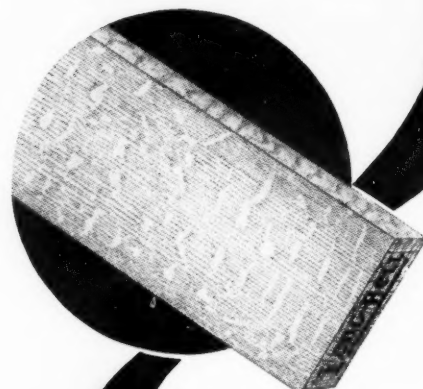
How can you know, when you buy hardwood lumber, that it is going to be uniformly dependable?

Before you buy hardwoods you have a right to ask these questions:

- | | |
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| 1—Does the class of timber used produce excellent lengths and widths? | 5—Are they end-buttet with mitre-toothed saws? |
| 2—Are they manufactured in the manufacturer's own hardwood mills, equipped with modern band machinery? | 6—Are they carefully sorted at the chains? |
| 3—Is thoroughness given every detail of manufacture? | 7—Is every detail in sticking and drying carefully observed to insure best results? |
| 4—Is particular care given to uniformity of thickness—carefully edged, equalized and trimmed? | 8—Are they carefully graded, inspected and carefully handled? |

Long-Bell Trade-Marked Hardwoods answer "YES" to these questions.

The Long-Bell Lumber Company
R.A. LONG BUILDING Lumbermen since 1875 KANSAS CITY, MO.



LONG-BELL HARDWOODS

can be identified by the Long-Bell trade-mark on the end of the piece.

WHEN gear-box lubrication is figured on a cost-per-mile or cost-per-ton basis, then you will find

DIXON'S 677

most economical.

It cuts down power-loss in the gear-boxes and makes gears operate easily, quietly, and deliver full engine power at lowest cost.

Write for Booklet No. 78 G

Joseph Dixon Crucible Company

Jersey City,
N. J., U. S. A.

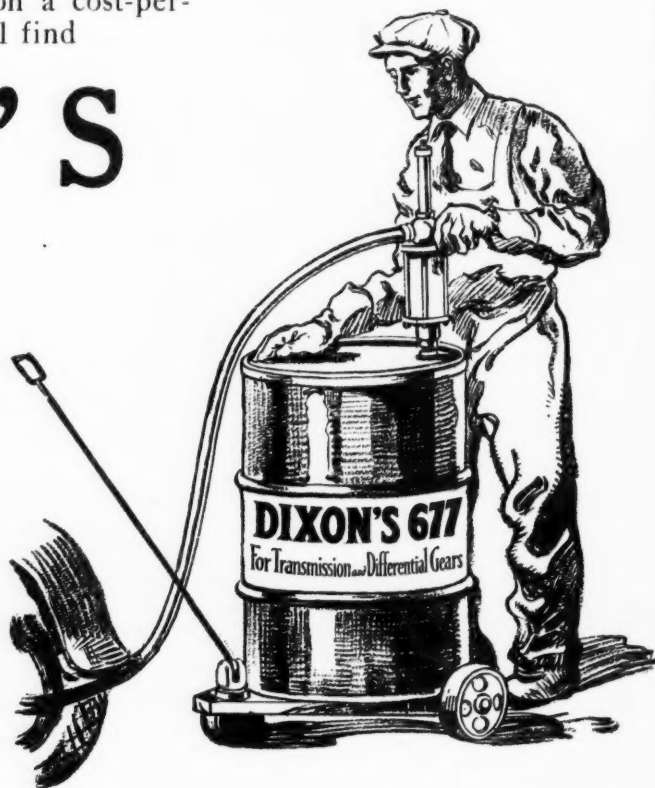


Established
1827

Makers of Quality Lubricants

For Spur and Bevel Gears Use Dixon's Gear
Lubricant No. 677

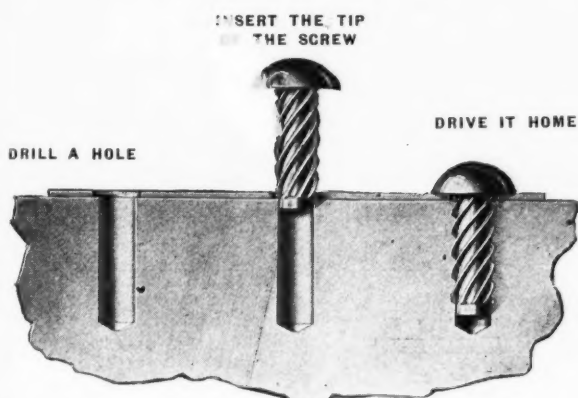
For Worm Drives Use Dixon's Gear Oil No. 675
For Universal Joints Use Dixon's Grease No. 672



The Most Costly Operation Eliminated!

Tapping holes—always the most costly operation in the use of machine screws—has been eliminated by hundreds of manufacturers through the use of

PARKER-KALON HARDENED METALLIC DRIVE SCREWS



Easy to use—they cut their own thread in steel, cast iron, bakelite, etc.

The Screw is so hardened that the steep spiral thread cuts into the material—under the blow of a hammer.

As simple as driving a nail!

The case-hardened thread cuts into the material, under the blow of a hammer.

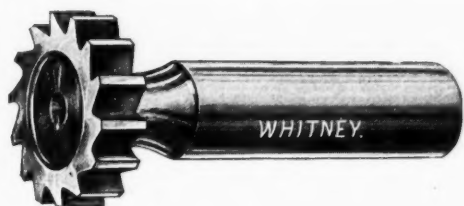
It has been repeatedly demonstrated that Hardened Metallic Drive Screws offer the best means of attaching name plates, number plates, brackets, etc. Many manufacturers are using them in the assembly of their products where a permanent fastening is desired. Wherever machine screws, escutcheon pins, expansion nails and the like are used, it will prove worth while to investigate the possibilities for saving time and labor that these Screws offer.

Samples for experiment will be gladly supplied. Write

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Dept. AI. 352 West 13th St., New York

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KEY SEAT CUTTERS



FOR THE

Woodruff System of Keying

GET OUR PRICES

“Whitney” Spring Collet

The use of this Collet insures cutters running true and avoids damage to the shanks.



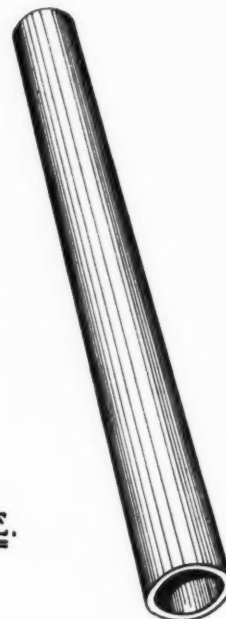
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TRANSMISSION CHAINS

KEYS AND CUTTERS

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DRIVE SHAFTS. STEERING TUBES.
TORQUE TUBES. DRAG LINKS.
WHEEL TUBES. TIE RODS.
FORMED TO ANY SPECIAL SHAPE.

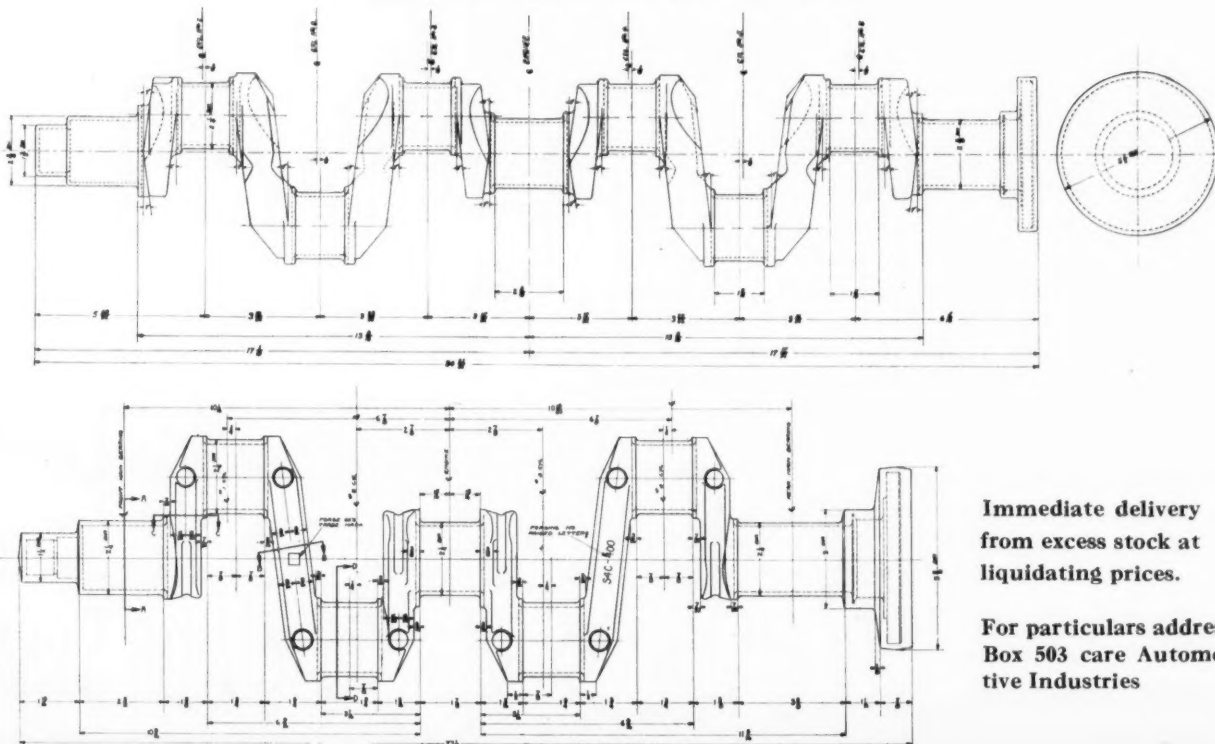
GLOBE DELIVERIES DEPENDABLE.

GLOBE STEEL TUBES CO.

MILWAUKEE. CHICAGO. DETROIT. INDIANAPOLIS. NEW YORK.

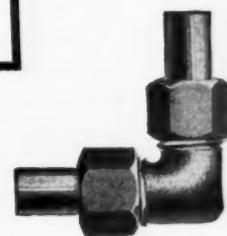
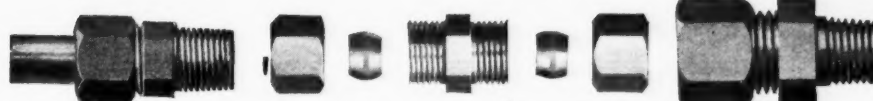
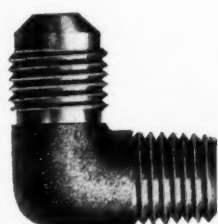
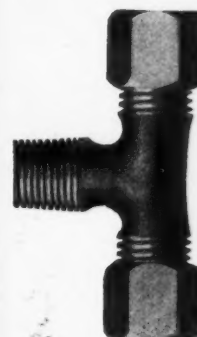
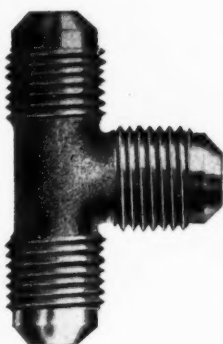
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4 and 6 cylinder, as shown



Immediate delivery
from excess stock at
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motive Industries



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WE always aim to carry in stock a large assortment of the standard fittings most in demand by the automotive trade.

WE SPECIALIZE IN THE PRODUCTION OF:

Ball Solderless Fittings
Standard Pipe Fittings

S. A. E. Flared Tube Fittings
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If your requirements call for a special part made from brass rod or casting, a blue-print or sample will receive our prompt consideration.

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DIE CAST AND SAND CAST

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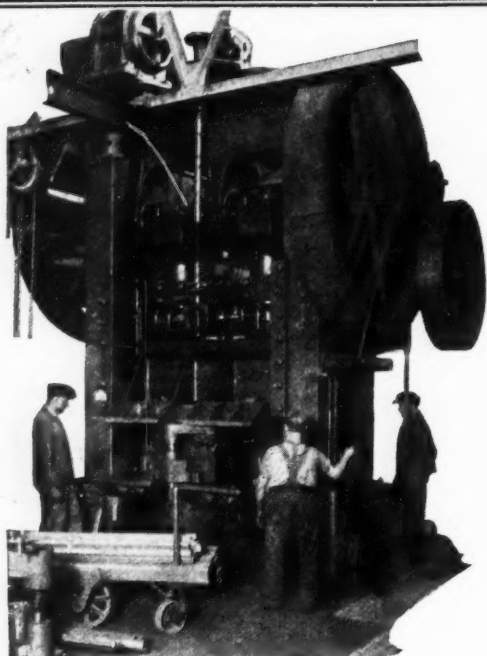
PIONEERS *of the* ALUMINUM PISTON

The WALKER M. LEVETT CO.

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New York City

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WE SUPPLY, FOR PRODUCTION, THE PRINCIPAL USERS
OF ALUMINUM PISTONS IN THE UNITED STATES



Photograph by courtesy of our customer

Double-Crank Presses



IN THE PICTURE is shown a BLISS No. 12 Double Crank Press perforating at one time rivet holes in two tractor side frames. The rivetting of the angle iron and frame is done with BLISS Rivetting Presses.

BLISS Double Crank Presses, combining accuracy, durability and convenience, are built in over one hundred and fifty types and sizes. Weights range from 3000 to 600,000 lbs. They are particularly adapted for heavy stamping, punching, cutting, piercing, and trimming. There is a size to economically meet every requirement. BLISS on your machinery is more than a name, it's a guarantee.

Bliss for Machinery

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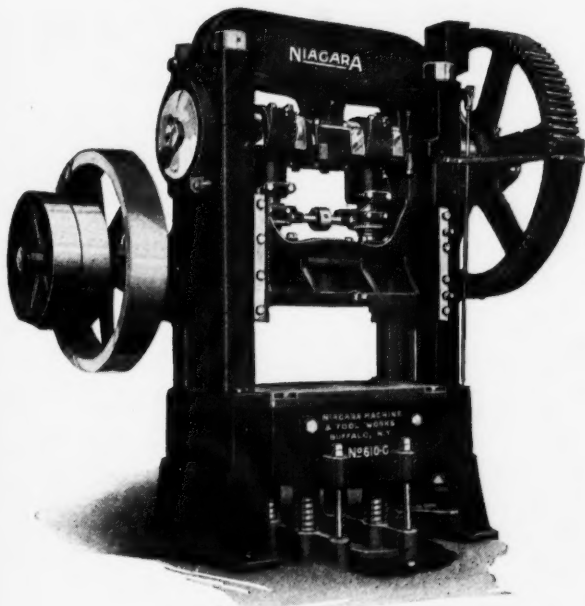
**"BARNES-MADE"
SPRINGS
ARE CONSISTENTLY
GOOD**

IF THE FINEST PRODUCT
YOU WOULD CHOOSE,
PUT YOUR FAITH IN
"VICTOR SCREWS"

CAP-SCREWS, SET-SCREWS,
CLEVIS PINS, STUDS,
SEMI-FINISHED NUTS,
CASTLE NUTS

VICTOR-PENINSULAR CO.
" DETROIT, MICH. "

SHEET METAL WORKING MACHINES & TOOLS



A Lasting Investment

When Niagara machines and tools are used in your shop it is put on a better production basis. Having worked for nearly half a century on sheet metal working problems Niagara engineers know how to shorten the number of operations, reduce the labor and waste, and assure uninterrupted service.

"Put it up to the Niagara Engineers" has resulted in a solution of many sheet metal problems.

Write for Bulletins on Presses, Punches,
Shears, Tanners' Tools and Machines.

NIAGARA MACHINE & TOOL WORKS

ESTABLISHED 1879

BUFFALO, N. Y.

U. S. A.

NIAGARA

POLLAK DROP FORGINGS

YOU are safe with
Pollak Drop Forgings.

We take no chances in
making them.

You take no chances in
buying them.

Send blue prints with inquiries.

Axles — steering knuckles
crankshafts — cam shafts —
connecting rods — levers —
gears — pinions.



Trade Mark

THE POLLAK STEEL CO.

Central Offices: Cincinnati

WORKS:

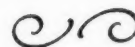
Cincinnati; Marion, O.; Chicago, Ill.

Quality Aluminum Castings Co.

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MANUFACTURERS OF
ALUMINUM CASTINGS
OF ALL DESCRIPTIONS



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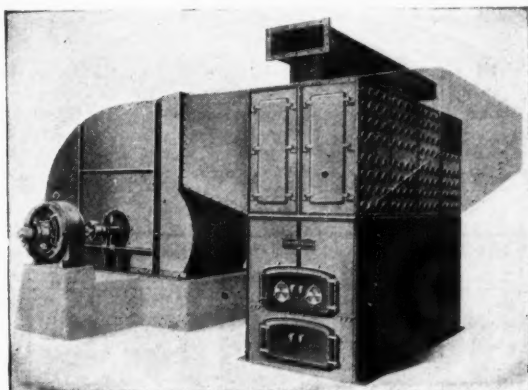
Ready for Production July 15, 1923
ANY QUANTITY

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The DRY-SYS method of high temperature baking of enamels produces temperatures, always under automatic control, ranging from 300° F. to 500° F., as desired.

In DRY-SYS the entire equipment is located outside of the oven. By it—quantities of fresh, pure air, washed free from dust and



heated by convection, are circulated in large volumes to every portion of the oven. By the elimination of direct heat, a source of dirt circulation is done away with and the space occupied by the radiating surfaces is put into use for baking.

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Jones was "up a tree"

*What was he to do?
Finally he saw LIGHT*

We are Prepared To Produce

*Engines
Engine Parts
Transmission Parts
Die Castings
Aluminum,
Bronze and Brass
Castings*

and likewise saw his plans materialize. He needed parts on short notice and found out where to get them.

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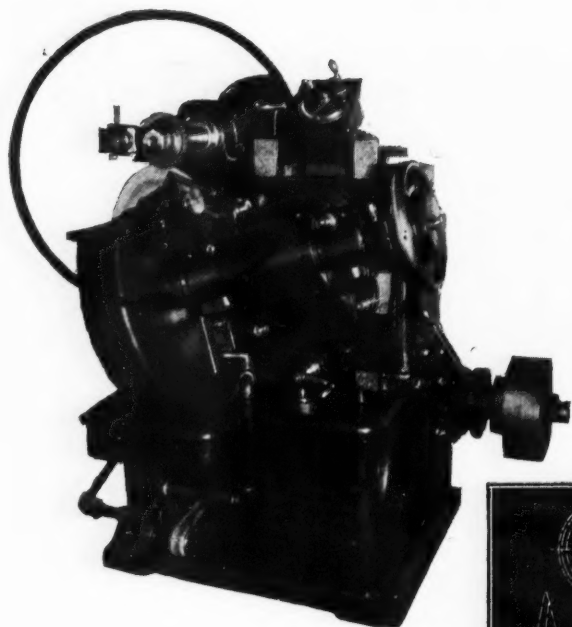
Our long experience in producing automotive parts—enables us to accept and fulfill quantity orders on short notice.

Quality product—superior workmanship insures highest grade service. What are your requirements? Send us samples or blueprints.

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quotations from
LIGHT.*

LIGHT
MFG. & FOUNDRY CO.

Pottstown, Pa.



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**GROUND
Gear-Teeth**
at a new high rate



NEW gear-tooth generator grinds one side of the average transmission gear-tooth in 4, 5 or 6 seconds. Less than 1 second is required for the indexing operation. A feature that makes for greater productive ability is the location of the work ABOVE the grinding wheel, a more natural loading position.

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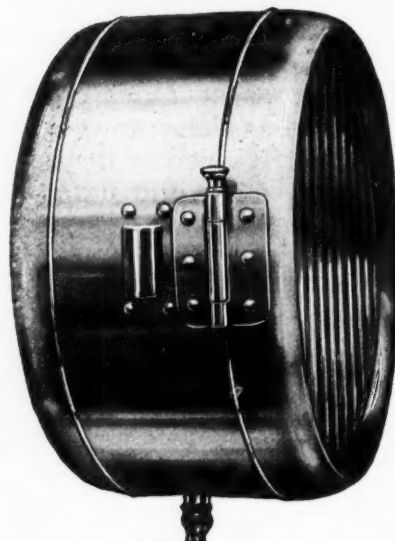
Our experience and progressive methods give you better castings at lower prices.

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Our G-1, G-2, and G-3 Headlamp shown at left, represents the highest type of the Lamp-maker's art.

This same distinctive style is embodied in our G-7 Side Lamp, G-5 Tail Lamp, and G-31 Spot Light.

All Aga Lamps combine beauty of appearance, accuracy of design and are noted for their sturdy construction and length of service.

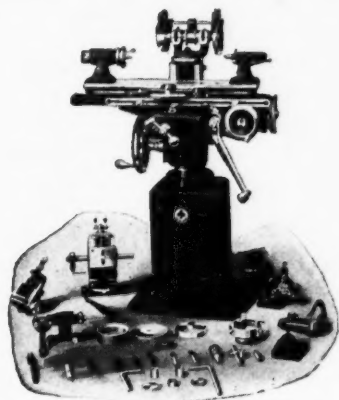
Aga Headlamps, Side Lamps, Tail Lamps, Searchlights, Spotlights in All Black, Black and Nickel, Black and Brass, All Nickel, All Brass, according to your requirements.

Our excellent facilities make it possible for us to render you prompt and splendid service. Let us quote on your requirements.

**AGA AUTO LAMP CO., Inc., Successors to
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A GRINDER BUILT ON THE PRINCIPLE OF THE
UNIVERSAL MILLING MACHINE—

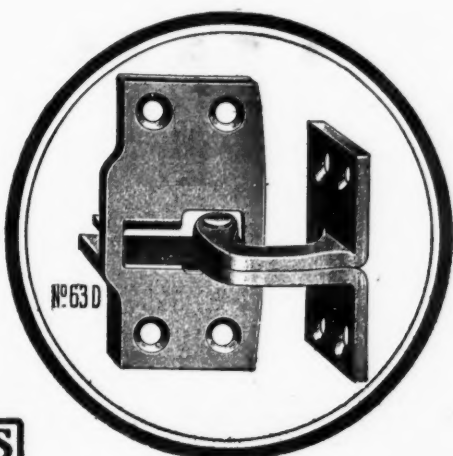
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with a column, knee, saddle, swivel table and full universal adjustments all accurately indicated by graduated dials. The machine is absolutely universal and will grind any angle, taper or face. It is adapted for grinding all kinds of cylindrical, internal, face and angular work, face mills, end mills, reamers, counter boxes, circular saws, snap gages, gear cutters, flat surfaces, and all other tool room work. We offer a complete line of attachments.

Its distinctive features are described in detail in our catalog on tool room grinding.

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PAT. 4-27-20

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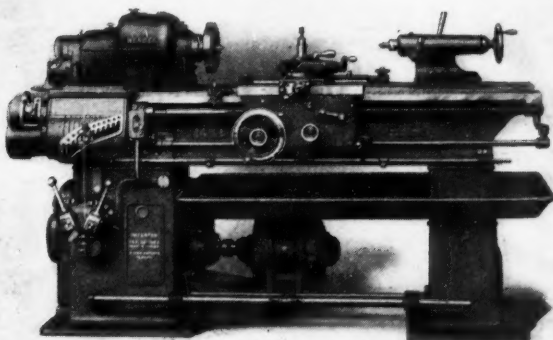
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Quality Die Castings



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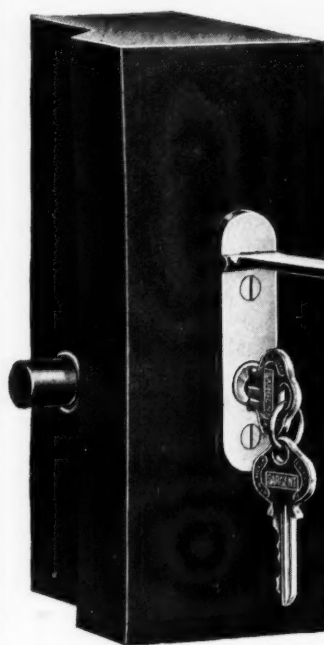
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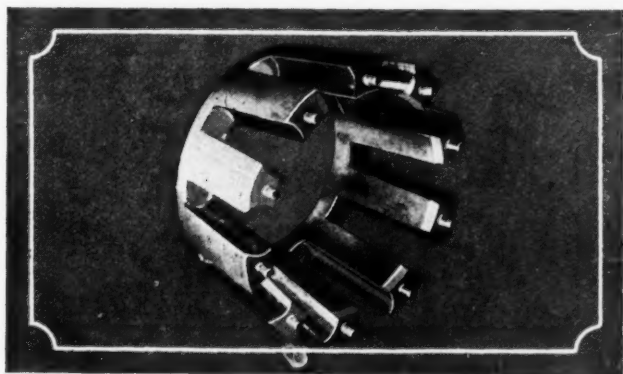


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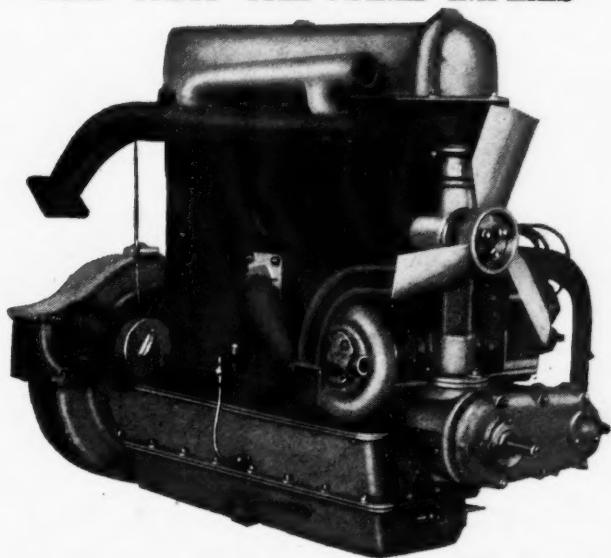
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"ALL THAT THE NAME IMPLIES"



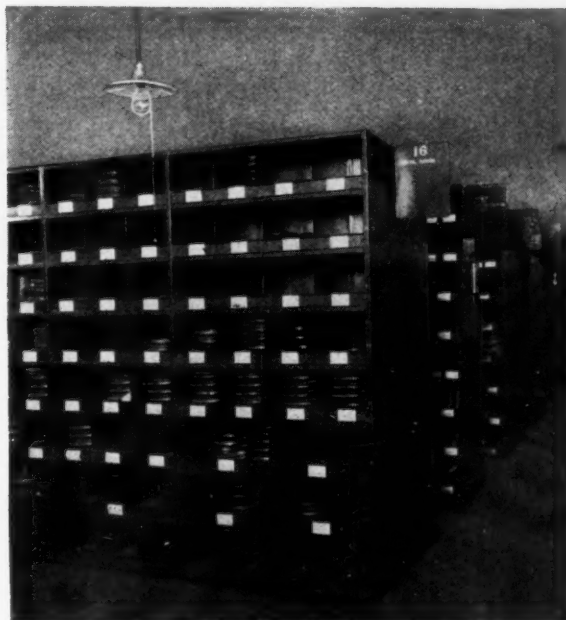
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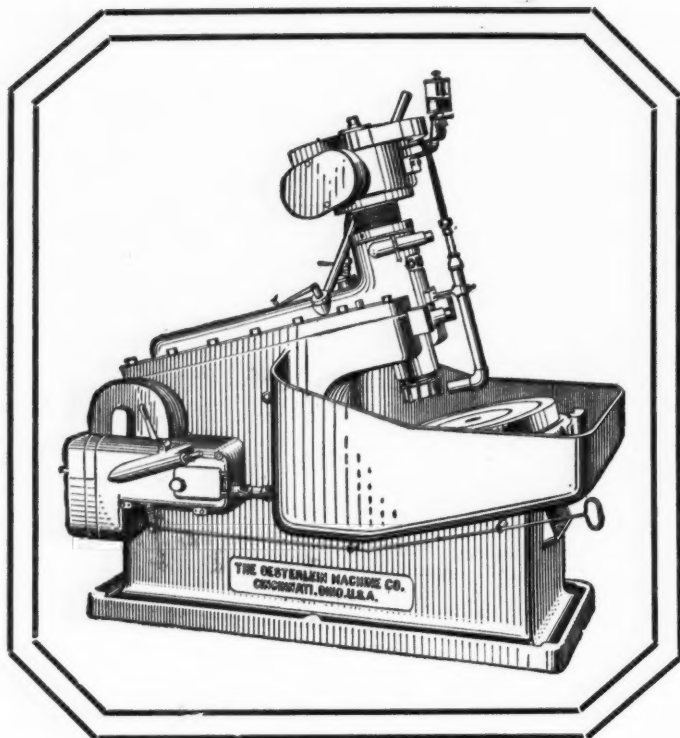
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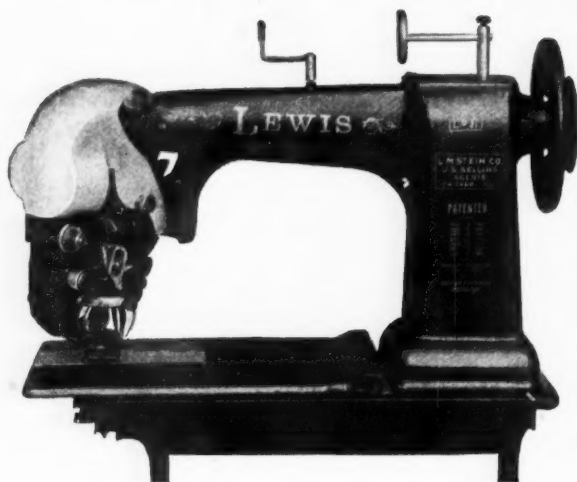
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The manufacturing, jobbing, retail and service fields are covered by the three sections into which this List is divided. For direct circularization, for planning the work of salesmen and for reference purposes this Mailing List is indispensable.

Send for specimen pages and details.

THE AUTOMOBILE TRADE DIRECTORY
239 West 39th St., New York

Beaver

MILWAUKEE

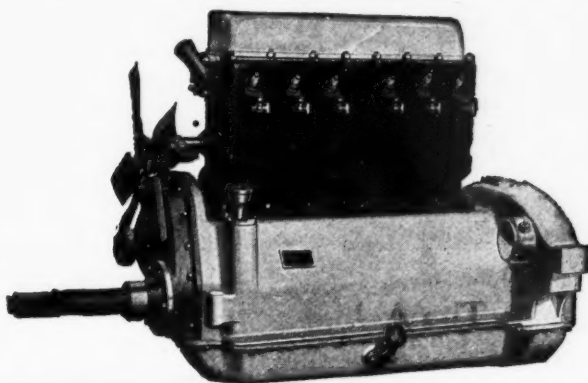
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Tack on as you would a cord welt and fold the half oval mould down over the tack heads. They are completely hidden. "WIRE-ON," due to its solidity, requires less tacking than any other welt of similar character, and goes on fast, a big item of time saved.

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Veeder

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record the mileage and indicate accurately the cost-per-mile for *all* expense-items.

Your truck user's *control* over this cost-per-mile goes as far as the thoroughness of his cost-keeping and his interest in saving money.

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CYCLONE HOISTS
HIGH SPEED

—give one man
the strength of a giant

AN 80-lb. pull on the hand chain of a Cyclone Hoist will lift a ton.

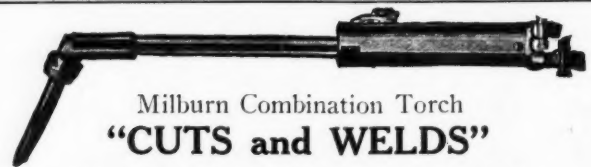
If suspended from a Chisholm-Moore "Matchless" Trolley a 14-lb. pull will carry this one ton load to any point where the overhead track leads.

Cyclone Hoists multiply man power! One man with a Cyclone can replace a gang of men using strong-arm methods.

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"A double duty oxy-acetylene torch"

This torch cuts 18-inch steel and welds any thickness by a mere change of tips.

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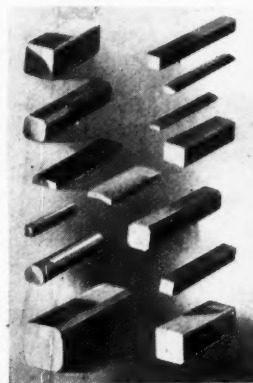
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Raymond WIRE Springs

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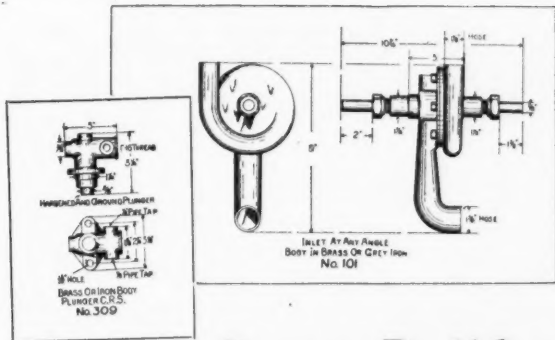
temperature instruments

assist the operator of the heat treating furnace to maintain uniform quality production. Tycos Pyrometers make this possible. Tycos Pyrometers are dependable.

Write for Catalog Part 4000-A.

Taylor Instrument Companies
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There's a Tycos and Taylor temperature instrument for every purpose. AN



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The Atlas **STANDARDIZED** Pump.
8 types, 9 sizes. 1/8\"/>

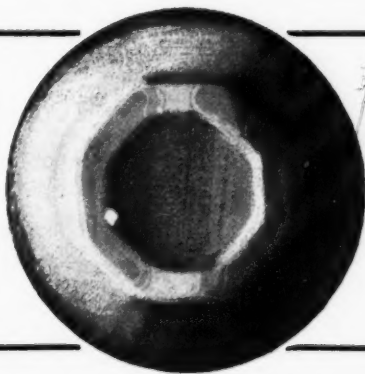
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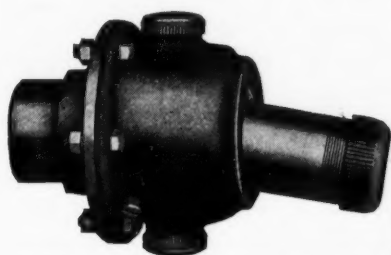
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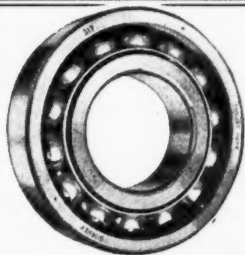
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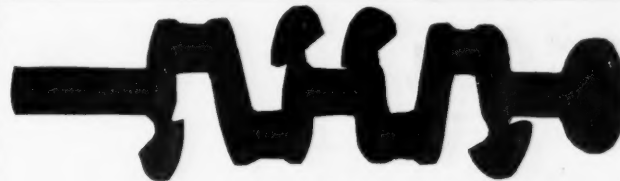


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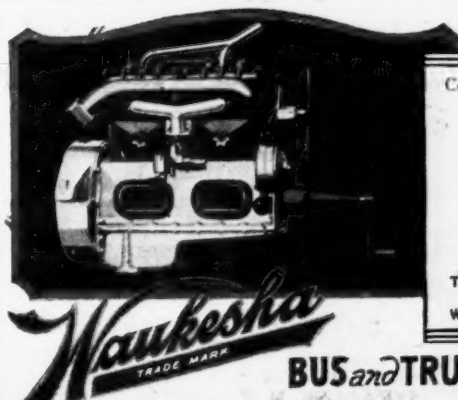
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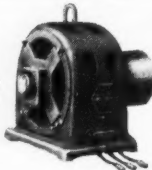
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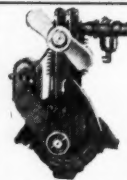
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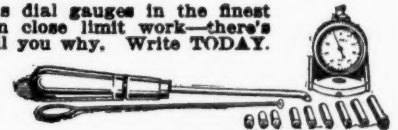
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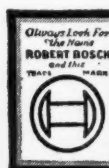
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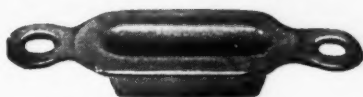
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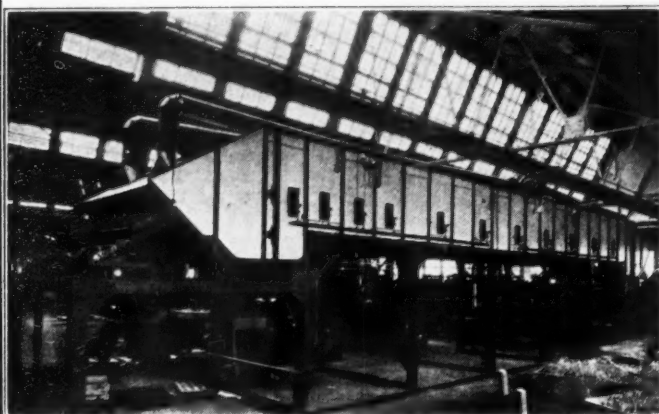
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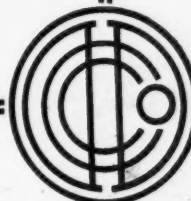
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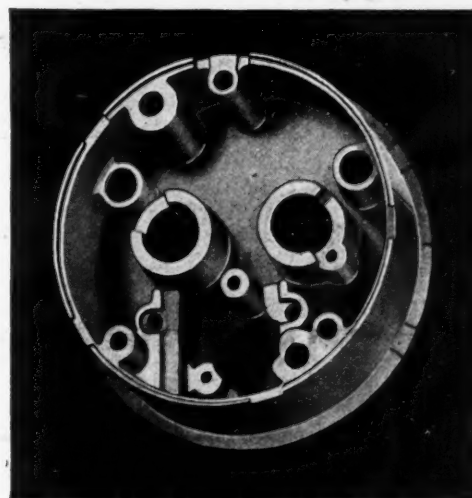
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DIE-CASTINGS



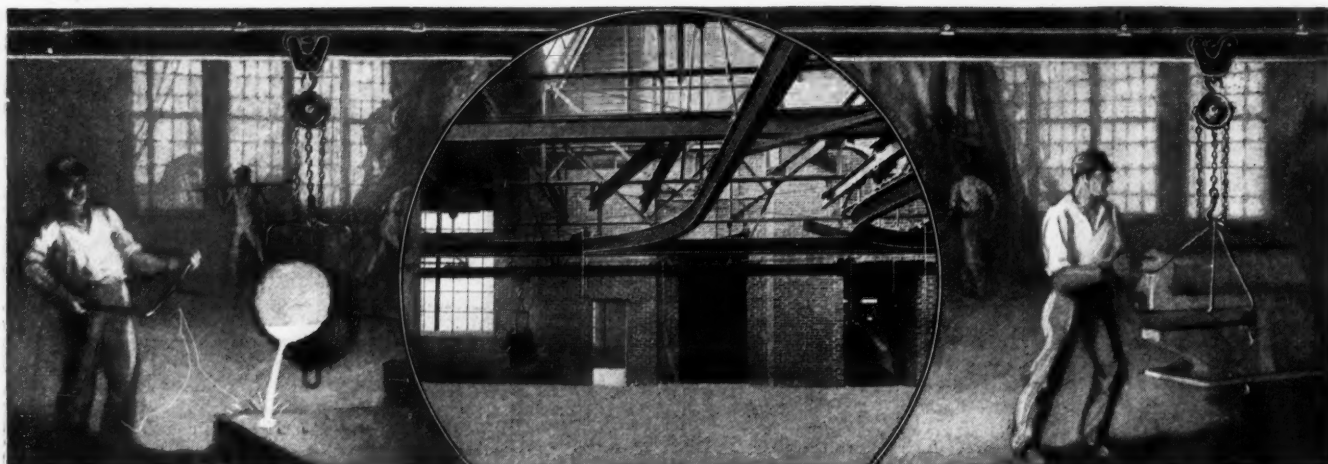
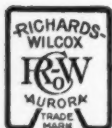
Doehler Die-Cast Zinc Alloy Ignition Housing

The purchase of Doehler Die-Castings is not merely the purchase of a quantity of finished metal products.

It is also an investment in the reputation, the resources, the experience, the service, of the Doehler organization—the largest producers of die-castings in the world.

Your return on this investment is the security which reputation, resources, experience and service give—the knowledge that the Doehler name and responsibility are back of every Doehler Die-Casting you use.

DOEHLER DIE-CASTING CO.
BROOKLYN, N.Y.
TOLEDO, OHIO.



Handle the work with from start to finish

Nothing is so unnecessarily wasteful as the use of costly man-power for conveying raw materials and finished products about a plant. It slows up production, adds to labor costs and seriously decreases profits.

In hundreds of notable manufacturing plants, Over-Way Conveying Equipment is repeatedly repaying its moderate first cost by enabling one man to do the work of six. In the foundry, for example, it transports huge bull ladles with ease and absolute safety. It handles heavy castings through machining and painting operations, and speeds them to warehouse or shipping room. There is hardly a handling operation in your factory that can't be done more economically with Over-Way.

R-W Ball Bearing I-Beam Trolley

Rigid tests have demonstrated that the R-W Ball Bearing I-Beam Trolley is by far the most durable, most efficient and most easily operated trolley for foundry use. As an example of its ease of operation, a 1-ton load can be started with a 30-pound pull as against a 200-pound pull required to start a competitive trolley. Yet this is only one of many exclusive features, others being the dust-proof ball bearings, crowned wheel treads, improved lubricating system, safety bumpers and short wheelbase.

Free Engineering Service to Manufacturers

Our Engineering Department has solved conveying problems for practically every type of business. We can tell how Over-Way can be adapted to your peculiar requirements and submit complete plans and specifications, including estimated savings. This service is given without cost or obligation to any manufacturer who earnestly desires to modernize his plant, increase speed and quantity of production, and lower costs. Write for details of this service and a copy of Catalog W-29.

New York
Boston
Philadelphia
Cleveland
Indianapolis
St. Louis

Richards-Wilcox Mfg. Co.
A Hanger for any Door that Slides
AURORA, ILLINOIS, U.S.A.

Chicago
Minneapolis
Omaha
Kansas City
Los Angeles
San Francisco

RICHARDS-WILCOX CANADIAN CO. LTD.
Winnipeg LONDON, ONT. Montreal

TREAT IT ROUGH!



A slight turn to the right locks the "DOT" case-hardened steel nozzle solidly to the steel nipple and opens valve. A slight turn to left closes valve and disconnects gun. No need to turn back the handle—pressure can remain, ready for the next operation. Saves time and energy!

TAKE a good look at the "DOT" high-pressure lubricator. Bang it, throw it, drive over it! You'll find the "DOT" fully deserving of its reputation as the most **RUGGED**, as well as the **MOST POWERFUL**, one-hand grease and oil gun made.

Especially at the nozzle—the "weak link" in most guns—the superior sturdiness of the "DOT" is unmistakable. In operation or in the tool box, the "DOT" carries no "handle-with-care" precautions.

In two years, sixty-two wide-awake car and truck manufacturers have adopted the "DOT" system as standard equipment.

Note the simple, direct, solid connection afforded with the "DOT." The "DOT" is the *original* system embodying this principle. And though imitated, it is to-day the only direct-connection, one-hand system with the necessary sturdiness and positive sealing mechanism to withstand leakless high

pressure under the common rough usage a grease gun receives.

With the "DOT" 3000 pounds pressure can be exerted with one hand by a man of average strength!

With its solid connection, positive seal and automatic valve the "DOT" can be used for oil as well as grease.

CARR FASTENER COMPANY, Boston 39, Mass.

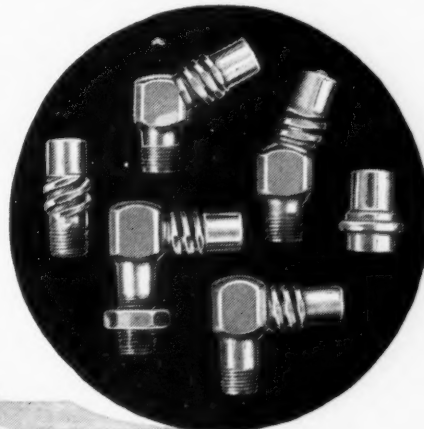
Makers of the "DOT" line of fasteners

Branch Offices—40 Selden Ave., Detroit; 47 W. 34th St., New York

CARR FASTENER CO. OF CANADA, LIMITED, HAMILTON, ONT.

The **DOT** *high pressure*
LUBRICATOR

ONE HUNDRED leading jobbers and ONE THOUSAND dealers sell the "DOT." Send for descriptive folder.



The "DOT" series of nipples can be adapted to all lubricating points on any chassis. These, with the simple "DOT" connecting mechanism, make the "DOT" absolutely a **ONE-HAND** system.

Nowadays Car Owners Know Carburetors



If the carburetor on their car does not return the mileage that a different carburetor on their neighbor's car delivers, *they know it*. A carburetor is no longer a mystery. It is no longer sacred because the manufacturer of the car has selected it as standard equipment. *It must deliver the miles per gallon!*

All cars equipped with the new Tillotson non-air-valve, fixed venturi carburetor have well recognized records of economy. Simpler Tillotson design reduces service needs. Frequent adjustments are not necessary.

A carburetor can build or destroy good will for a motor car. *Tillotson economy and simplicity builds it!*

Tillotson engineers are busy, but not too busy to show more manufacturers exactly what Tillotson can do for them to gain greater public regard.

TILLOTSON MANUFACTURING CO. • TOLEDO

Tillotson
CARBURETOR

